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INTERSTATE IDAHO 90

SUMMARY REPORT OF JOINT ROUTE STUDY

MULLAN - SALTESE JOINT ROUTE STUDY

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Interstate Highway 90 will eventually span the continent, linking Seattle and Boston via Coeur d'Alene, Butte, Rapid City, Chicago, Cleveland, and Buffalo. Only two other routes of the Interstate Highway System will have numerical continuity extending from coast to coast.

SUMMARY REPORT OF JOINT ROUTE STUDY FOR INTERSTATE HIGHWAY 90 BETWEEN . . .

MULLAN & SALTESE

IDAHO MONTANA

Based on Technical Data Developed by
IDAHO DEPARTMENT OF HIGHWAYS
and
MONTANA HIGHWAY COMMISSION

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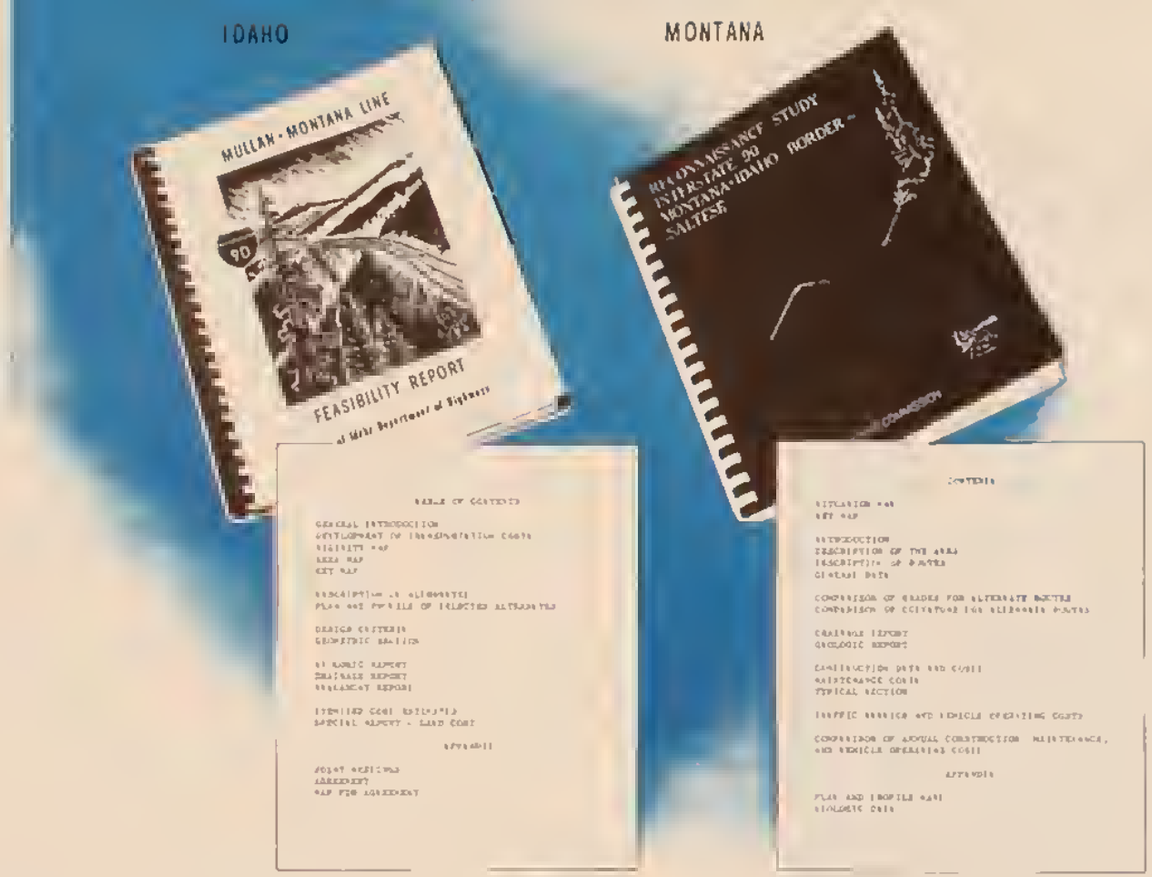
FOREWORD

The joint Idaho - Montana route study investigated an 85 square mile area centering upon St. Regis, Lookout, and Mullan Passes which breach the Bitterroot Range on the Idaho-Montana State Line. The mountain barrier proved as formidable an obstacle to interstate highway location as it did construction of the Mullan Road a century before.

U.S. Highway 10 connects the two states at Lookout Pass. The distance between Mullan, Idaho and Saltese, Montana - west and east study terminals respectively - is 18 miles.

Planning Background

Original efforts toward locating an improved highway route in the vicinity of the subject study area were launched by the Idaho Department of Highways in 1955. This reconnaissance by Idaho anticipated the 1956 Federal Highway Act which provided funds to begin construction of the Interstate Highway System.

By 1958 it had become obvious that the study area should not be dissociated from its counterpart in Montana, and that a more comprehensive feasibility study should be undertaken to include both surface and tunnel routes for the new highway.

Exploratory talks among representatives of Idaho, Montana, and the Bureau of Public Roads were begun in July 1959; in July 1960, a cooperative agreement was signed which stated in part that, "this agreement has been entered into because of the unique and extraordinarily difficult problem presented in this specific highway location."

Coordination and Cooperation

By early 1962, the two states had published technical reports (see cut) outlining the various alignments each state had analyzed in its zone of investigation. However, under the agreement, Idaho was to evaluate the technical findings of both states in a summary report which would recommend a combined route between Mullan and Saltese.

A high level of cooperation between the participating agencies was in effect at all times. Of particular value were the "interim meetings" held to update study data; these conferences also served to maintain a high degree of interest in study progress.

Final acceptance of the recommended plan by the Montana Highway Commission, Idaho Department of Highways, and Bureau of Public Roads is to terminate Phase One of the 1960 agreement.

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SUMMARY

The scope of the route studies herein is indicated by the following general statistics: Idaho investigated a total of 109 miles of alignment for 16 plans at a cost of $60,000; Montana examined 93 miles for nine routes at a cost of $40,000.

Nine of the Idaho plans were disqualified during very early study phases. Eliminations were due to great length and the existence of topographical and geological problems which would have resulted in prohibitive construction costs or unnecessarily hazardous operating conditions.

Montana's original nine plans, in combination with various Idaho plans were considered through the advanced study phases.

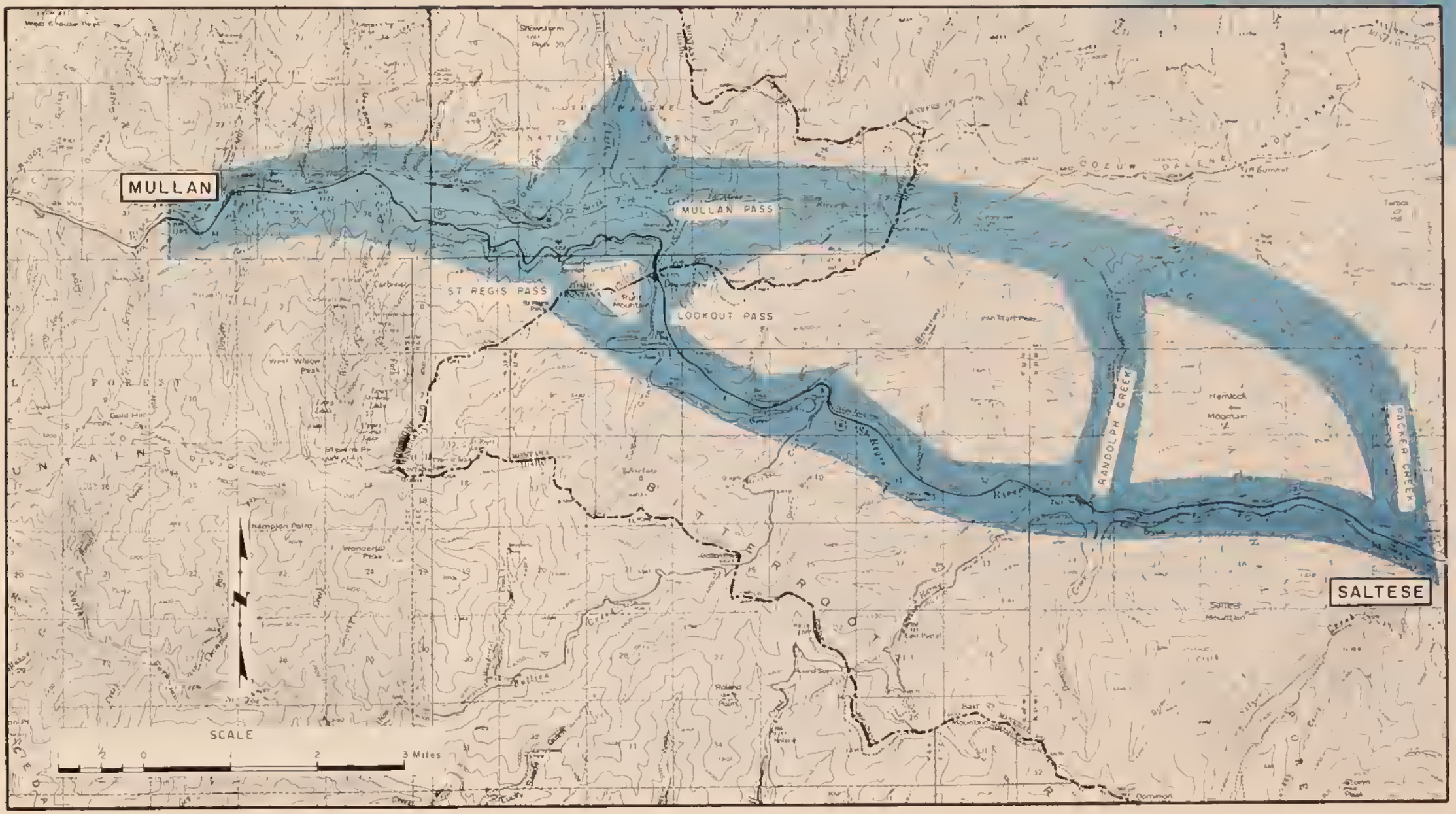
Major efforts of the study were concerned with evaluating 11 combined alignments along the basic corridors depicted in Figure 1. The basic routes connected via two surface locations and a tunnel location at Mullan Pass; a St. Regis Pass tunnel; and a surface location and a tunnel location at Lookout Pass.

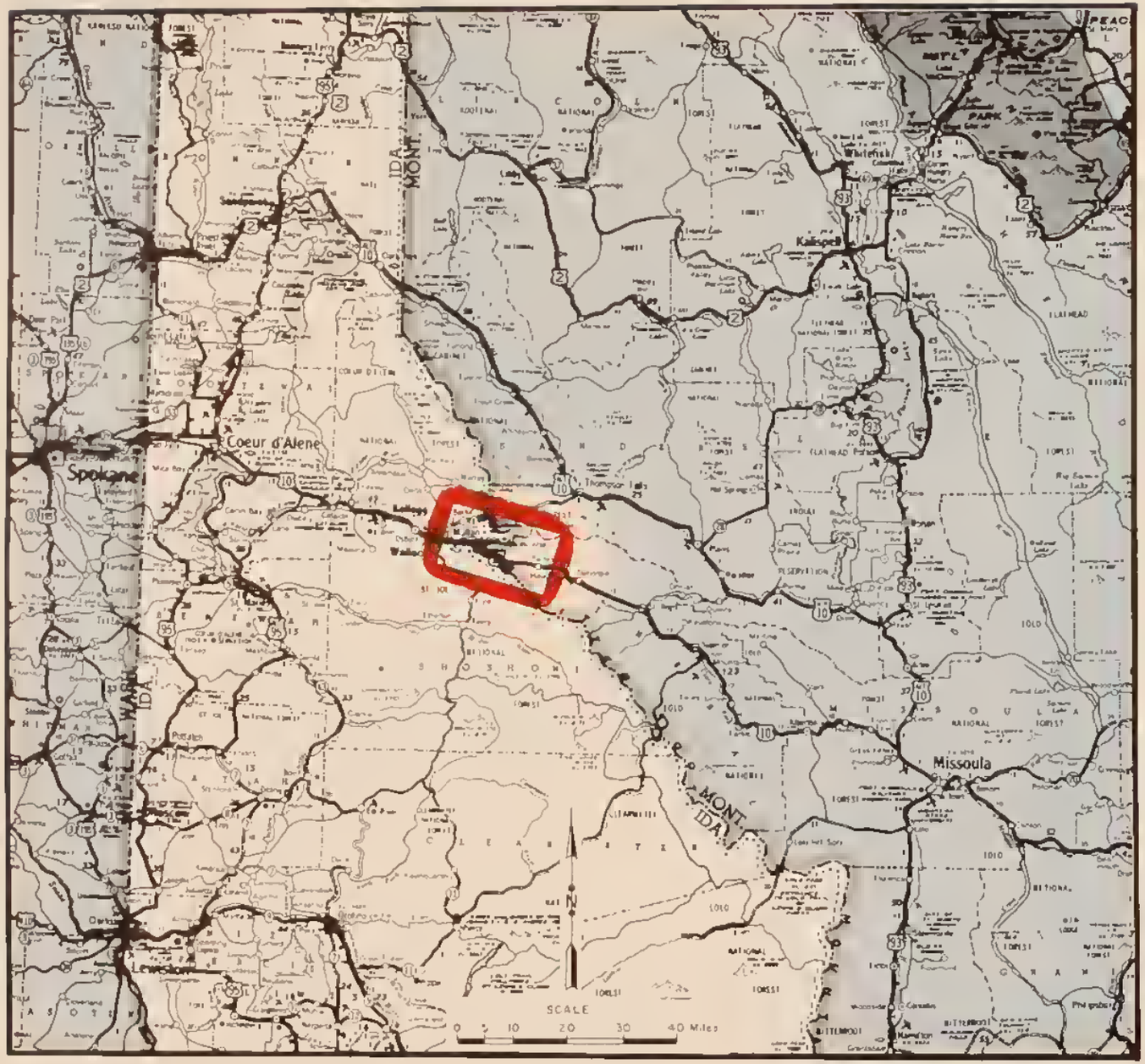
Each of the five most favorable combined plans was fairly competitive when compared for construction costs and annual transportation costs. As might be expected, the St. Regis Pass tunnel route, and those surface routes with most moderate gradient, would be most expensive to construct. (See Summary Table, page 22.)

Topography, winter climatic conditions, and geological circumstances were the prime factors which ultimately controlled route selection. Steeper slopes and greater snowfall west of the summit dictated the use of five percent maximum grades in Idaho. More moderate natural conditions in Montana, plus the favorable record of existing U.S. Highway 10, did not require this limitation east of the summit.

It was concluded that a Lookout Pass surface plan, with five percent maximum Idaho gradient and six percent maximum gradient in Montana, would be the most reasonable alignment. Therefore, it is the recommendation of this report that such a location be approved between Mullan, Idaho and Saltese, Montana.

BASIC ROUTE CORRIDORS





THE STUDY AREA

Topography and Climate

The cover photograph shows a typical profile of the Bitterroot Mountain Range. Locally, many peaks exceed 6000 feet in elevation. Deep parallel drainage channels are separated by prominent ridges with occasional rock outcroppings and the entire area is totally forested. The chief stream west of the summit is the South Fork of the Coeur-d'Alene River, and on the east, the St. Regis River. Both are in the Columbia River watershed.

Geological processes which shaped the region also formed extensive mineral deposits which helped earn for Montana the nickname "Treasure State" and for Idaho, "Gem State". The area abounds in creeks and gulches named Gold, Bullion, Silver, Borax, Paymaster, Gold Hunter and Klondike.

As shown in Figure 2, the regional annual precipitation varies from 30 inches at 3000 feet elevation to plus 40 inches above 4000 feet. The climate is commemorated in such names as Snowstorm Peak and Rainy Creek. Idaho stations in the immediate locality receive up to 25 percent greater annual rainfall than comparable Montana points.

Communities and Land Use

As a result of restricted local land uses, the study area's two communities have small populations. The 1960 Census indicated 1477 persons in Mullan, Idaho and 85 in Saltese, Montana.

Mining of subsurface ores, harvesting of forest products and the seasonal pursuit of outdoor recreation are the basic forms of local land use. In view of their specialized nature, these activities are not likely to generate rapid changes in either the economy or the population of the area.

The Northern Pacific Railway's spur line to Wallace, Idaho utilizes Lookout Pass; its alignment between Saltese and Mullan is an outstanding example of the resourcefulness of early day location engineers. Mine to smelter ore shipments presently comprise the bulk of railroad freight on the line.

The Missoula-Seattle mainline of the Chicago-Milwaukee-St. Paul and Pacific Railroad parallels the Northern Pacific's spur for approximately five miles west of Saltese. It then curves southwest to a tunnel beneath St. Paul Pass.

The study area occupies a part of three national forests - the St. Joe, the Lolo and the Coeur d'Alene.

RELATIONSHIP BETWEEN ELEVATION AND PRECIPITATION

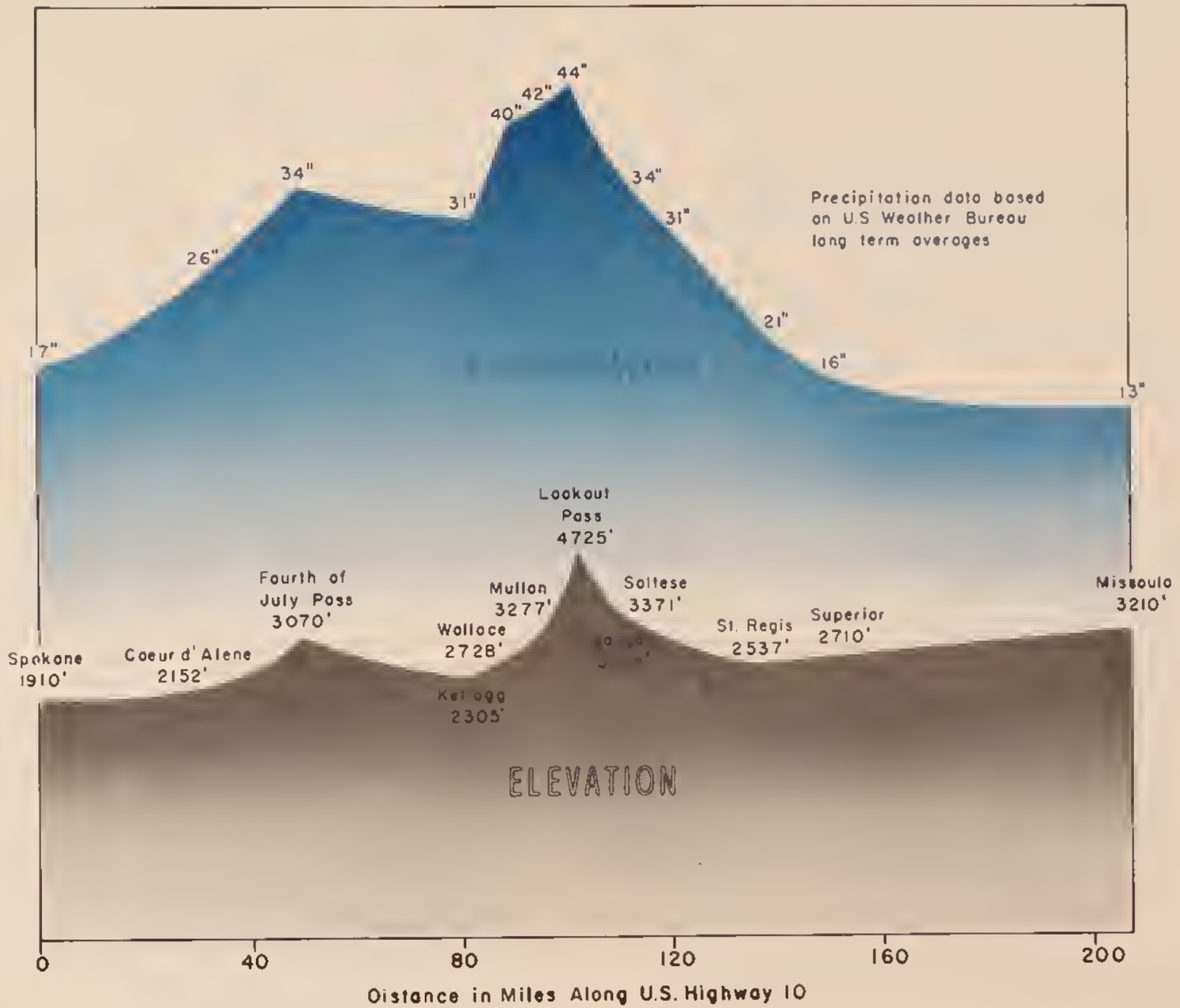


FIGURE 2

U.S. HIGHWAY 10

U.S. Highway 10 links Seattle to Detroit via the northernmost tier of states. The road attains one of its maximum points of elevation at Lookout Pass, as shown in the illustration on page 5. Its operational record in the immediate vicinity of the pass demonstrates the fact that mountainous terrain is not an insurmountable problem in modern highway location.

Historical Note

Transportation requirements during the mid-1800's between Fort Walla Walla, in Washington Territory and Fort Benton, on the Missouri River, resulted in the location and construction of a wagon road by an expedition headed by Captain John Mullan. The 624 mile road was completed in 1862 at a total cost of $230,000 and came to be known as the Mullan Road, shown in Figure 3.

The frontier route followed the South Fork of the Coeur d'Alene River, passing near the present site of Mullan, and crossed the summit of the Bitterroot Range at present day Mullan Pass. Turning south, the road descended along Randolph Creek to the St. Regis River Valley and continued east beyond Saltese.

It is interesting to observe that the Mullan Road alignment was very seriously considered in both Idaho and Montana during the Interstate Highway Study.

The later discovery that Lookout Pass is over 450 feet lower than Mullan Pass brought about relocation of this section of the roadway through the lower pass. The new location also provided a more direct route across the mountains. Later re-named the Yellowstone Trail, it was improved when conditions allowed, paved in the 1920's, and designated as U.S. Highway 10 in 1926.

The original Mullan Road in this area has continued in use as a forest access road to present times.

Existing Conditions

Near Mullan, the highway crosses the river and is directed generally eastward along the valley floor as shown in Figure 3. Approximately two miles from Mullan, it begins the summit climb up the south valley wall, passing over the railroad once. A half-mile from Lookout Pass, the highway

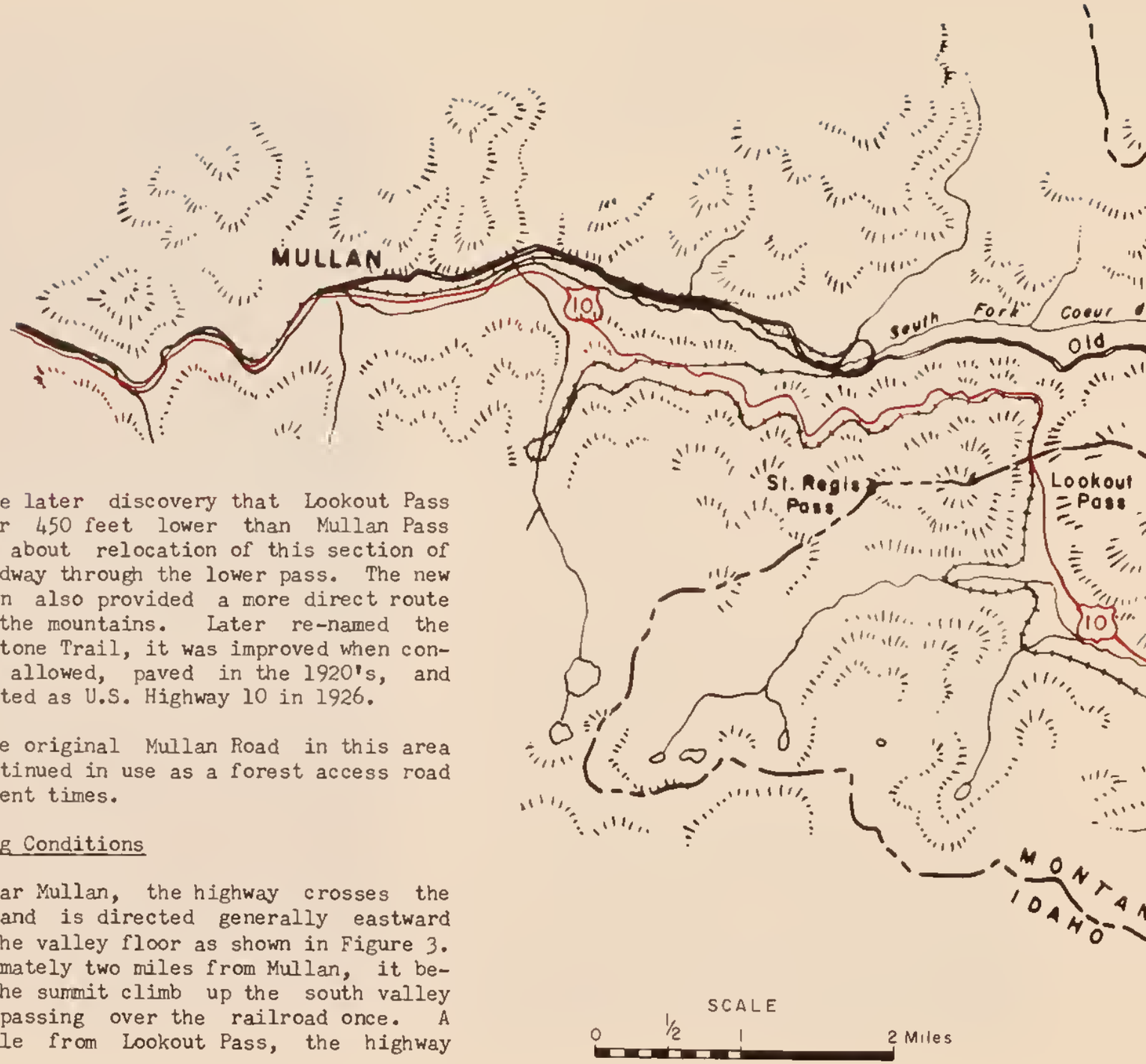


FIGURE 3

turns due south, crosses the pass, and begins the descent along the more moderate north slopes of the St. Regis River Valley. Two miles beyond the summit, the highway again turns east and becomes parallel to the railroad. There are two crossings of the facilities enroute to Saltese.

The highway climbs 1,448 feet in the six miles between Mullan and Lookout Pass, and lowers 1,354 feet in the 11 miles between the pass and Saltese. By expanding mileage to feet and dividing the result into the difference in elevation in each case, an overall grade of 4.6 percent in Idaho and 2.3 percent in Montana is obtained. Since both communities are at approximately the same elevation, this comparison strongly illustrates the contrast in topography of the two study sectors.

During past modernization of the highway, consideration for practical highway economics imposed the necessity of minimizing and balancing earthwork quantities between cut and fill sections. Balancing of quantities in the local terrain created a "contouring" effect, so that the road's alignment includes successive series of compound and reverse curves.

Fitting specified curvature and gradient to route terrain during the subject studies likewise proved to be a real challenge.

Connecting Roads

Neither Shoshone County, Idaho nor Mineral County, Montana operates a local road network in the study area, and there are no state numbered highways. There is a paved Federal-Aid Secondary road to a state fish hatchery east of Mullan, and service roads to the Lookout Pass ski area and FAA communication towers nearby. Access roads to mining property and forest areas and jeep trails are numerous in the general vicinity.

FIELD STUDIES

Existing Traffic Characteristics

Observation of existing traffic movements revealed that most travelers continue through the study area non-stop. An Origin and Destination survey conducted at Mullan in 1958 showed that, of all recorded trips, 60 percent were non-stop.

The amount of local trips and those making intermediate stops at Saltese are much lower, due to the more limited facilities available there.

Routine traffic counting schedules showed that approximately 1500 vehicles crossed Lookout Pass on U.S. Highway 10 on an average day in 1960. This figure represents an increase of 110 vehicles in the two years since the Mullan traffic survey, and is indicative of ever-increasing national volumes.

Locally, present vehicle volumes are comprised of 88 percent passenger cars (including light trucks) and 12 percent commercial vehicles (large trucks and buses).

Future Traffic Volumes

Based on existing traffic volumes using U.S. Highway 10 between Mullan and Saltese, and applying normal traffic increases, average daily traffic for the year 1975 was expanded to 3600 vehicles.

The use of traffic assignment processes commonly used in a study of this nature was considered to be unnecessary due to the small amount of local traffic.

Photogrammetric Mapping

Establishment of precise horizontal and vertical control points was made possible by use of modern equipment such as radar units for distance measurements and theodolites for measuring angles. Survey crews adopted special techniques to overcome many problems associated with the extremely rugged terrain. The procedure of projecting accurate elevations to inaccessible control points by combining tellurometer distances with vertical theodolite angles was particularly useful. This method produced results well within tolerances prescribed for highway location.

Established control points were marked for identification in aerial pictures, and the entire 85 square mile area was flown and photographed. Maps were compiled from the aerial photographs to a scale of one inch to 400 feet with contour interval of 20 feet.

Possible Interstate Highway routes were plotted on the maps by location engineers of each state. Horizontal and vertical measurements were then transferred to computer cards for electronic calculation of optimum alignment and grade and required earthwork volumes.

Modern surveying equipment, such as this tellurometer, greatly expedited precise horizontal and vertical alignment control.

GEOLOGY

Until recent times, geological reconnaissance had a minor role in highway development. Present procedures include a professional analysis of the engineering properties of surface and subsurface rocks and soils.

The Osburn Fault

Most prominent of the area's geological features is the Osburn Fault which extends eastward for over 90 miles from the vicinity of Coeur d'Alene. It enters the study area at Mullan, forms Mullan Pass, and exits north of Saltese. In Idaho, the North Fork of the Coeur d'Alene River has developed along this rupture.

Geologic processes which shaped the Osburn Fault occurred over 17 million years ago. Locally, it produced a zone up to 500 feet wide, during lateral movement of approximately 16 miles and 10,000 feet vertically. No movement has been recorded along its alignment during the history of mining operations in this district.

Predominant Rock Formations

The Burke - Revette, St. Regis, and Wallace Formations are the main rock masses which make up the local topography. They are underlain by sedimentary deposits of pre-Cambrian age, whose rocks are among the earth's oldest.

Figure 4 shows typical outcroppings of the three formations as they appear in roadway cuts along U.S. Highway 10. They are made up primarily of quartzite and argillite, which occur in beds up to 6,500 feet thick.

Montana's St. Regis River Valley was carved by glacial ice. Overburden deposits from glacial and other sources exceed depths of 50 feet in some places.

Investigations

A corridor on each side of the Coeur-d'Alene River Valley was examined by Idaho geologists. The north corridor included Mullan Pass; the south corridor included Lookout and St. Regis Passes. Montana geologists studied each route alignment independently.

Natural ground slopes in Idaho were generally steeper than those in Montana, whereas there are more rock outcroppings in Montana. Soil and gravel deposits lie mainly along the rivers and tributary channels in both states.

The Osburn Fault is more of a problem on Idaho routes than on those in Montana. In addition, smaller faults are evident in both states, but do not constitute major design problems.

FIGURE 4

Top: Burke-Revette Formation (Quartzites).

Center: Wallace Formation (Argillites).

Bottom: St. Regis Formation (Quartzites and Argillites).

Due to the steeper Idaho slopes, the avalanche problem is of more concern than in Montana, although several such areas have been located there. This aspect is examined more fully from Idaho's viewpoint on page 11.

Visual reconnaissance during the field studies was supplemented by drilling, seismography, electronic units and photo interpretation.

Diamond Drilling at Possible Tunnel Sites

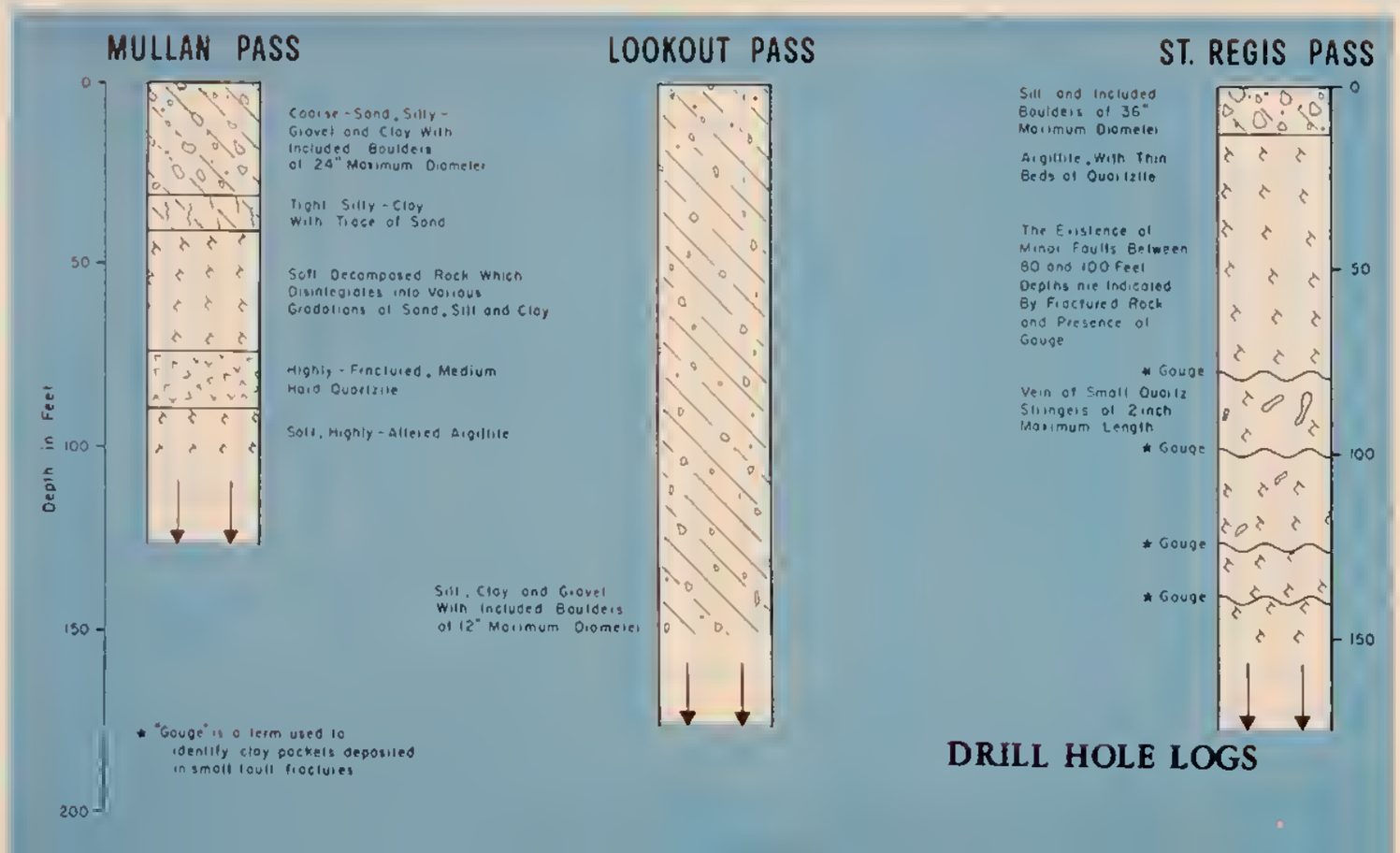
Properties of subsurface formations along potential tunnel sites at Mullan, Lookout, and St. Regis Passes were determined by diamond drilling. Figure 5 shows "logs" of typical drill holes at each of the three passes.

Strata underlying Mullan Pass vary from highly altered argillites to highly fractured quartzites of the Revette formation. Solid rock was not encountered in this area. Tunneling undoubtedly would be very costly due to the highly altered character of the rock.

St. Regis drilling encountered argillites and quartzites of the St. Regis Formation. Faulting has fractured the rock between depths of 80 and 150 feet.

Bedrock was not encountered at Lookout Pass. Drilling continued beyond the possible tunnel depth in an attempt to locate rock, but was discontinued at 152 feet.

FIGURE 5


MULLAN PASS
LOOKOUT PASS
ST. REGIS PASS
Depth in Feet
0
50
100
150
200
Coarse - Sand, Silty - Gravel and Clay With Included Boulders of 24" Maximum Diameter
Tight Silty - Clay With Trace of Sand
Soft Decomposed Rock Which Disintegrates into Various Gradations of Sand, Silt and Clay
Highly - Fractured, Medium Hard Quartzite
Soft, Highly - Altered Argillite
Silt, Clay and Gravel With Included Boulders of 12" Maximum Diameter
* "Gouge" is a term used to identify clay pockets deposited in small fault fractures
Silt and Included Boulders of 36" Maximum Diameter
Argillite, With Thin Beds of Quartzite
The Existence of Minor Faults Between 80 and 100 Feet Depths are Indicated By Fractured Rock and Presence of Gouge
* Gouge
Vein of Small Quartz Stringers of 2 inch Maximum Length
* Gouge
* Gouge
* Gouge
0
50
100
150
DRILL HOLE LOGS

Effects on Highway Construction

Extensive folding and faulting have modified many rock formations to talcy consistency. Also, at many places of possible roadway cuts, dip of solid rock is toward the road. In designing roadway cut backslopes, the talcy rock will require fairly low slopes in anticipation of rapid weathering and sloughing; solid rock layers will have to be excavated along the natural dip.

Faults, particularly the Osburn, should be avoided, since heavy cutting or structure location could create future problems.

Slide areas should be avoided or modified to reduce the possibility of further activity. Heavy filling over, or cutting into, slides might very well induce movement.

AVALANCHE STUDY

Avalanches occur as a result of snow masses accumulating on steep slopes. These conditions exist during many months of the year at high elevations, especially in Idaho. Economic effects of avalanches are reflected by higher maintenance costs or possible remedial costs during construction. Furthermore, there is always the danger to human life.

Figure 6 is a 40 year record of annual total snow depths at Lookout Pass.

Study Technique

Field studies, topographic maps, and aerial photographs were used to map actual and potential slide paths. As a result, all anticipated avalanche zones were established. Most of the area is heavily timbered, thereby providing a natural barrier to slides. The avalanche problem exists principally on open slopes.

Natural Slide Path Avalanches

Slide paths exist where avalanches occur often enough to prevent the growth of timber. This type of avalanche can be reduced or eliminated by: construction of friction - producing obstacles which allow reforestation to provide natural anchorage; dikes or mounds to deflect and reduce avalanche energy; snowsheds or bridges; relocation of the highway alignment. Adoption of any one treatment or combination would have to be subjected to more detailed study.

Cut Slope Avalanches

Large roadway cuts will cause avalanches where no problem previously existed. Although less impressive than the slidepath type, lives have been lost in them. The most effective treatment to combat cut slope slides is to reduce the slope angle and provide a series of benched berms and widened ditcbes for storage.

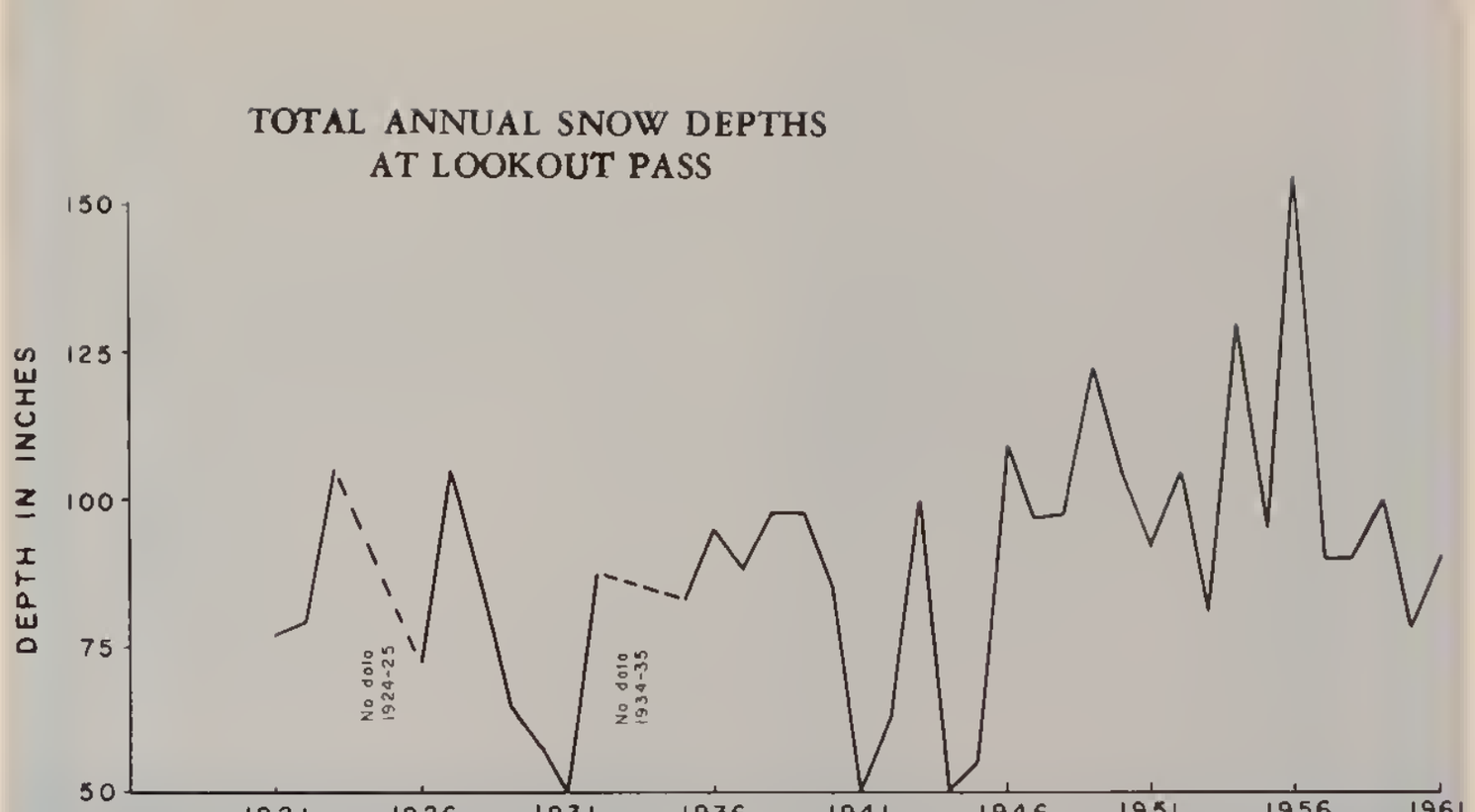


FIGURE 6

Summary

Existing slide paths intercept several routes, especially in the area of Mullan Pass. Additional avalanches might occur on large cut slopes unless preventive measures are taken. If the selected route does traverse avalanche terrain, additional studies will be necessary to develop the most economical solution.

The problem of assigning costs to avalanche conditions is extremely complicated. Additional initial costs, as well as anticipated maintenance costs have to be considered. However, control methods might be adopted which become part of a regular maintenance program.

Year around hydrological investigations included measurement of winter snowpack (above) and inventory of existing drainage structures (right).

HYDROLOGY

The application of hydrology in highway development measures the source and amount of natural water and suggests means by which the normal drainage pattern may be least disrupted by road construction. The design of bridges and culverts is one area that is affected.

Annual precipitation is 25 percent greater in Idaho's study zone, resulting in greater stored precipitation (snowpack) and heavier spring runoffs. All study area points receive above 30 inches of rain and snow a year. (This figure includes snowfall depths reduced to equivalent rainfall.)

Three types of local drainage areas were recognized: channel drainage, side hill drainage, and swamps and lakes. These areas ranged in size from less than a tenth of a square mile to over 18 square miles, with runoff rates of 30 to 640 cubic feet per second. A damaging flood occurred on the Coeur d'Alene River below Mullan in 1933. "Chinook weather" - warm winds accompanied by rain, causing accelerated thawing of the snowpack - was responsible for the flooding.

Recommendations for culvert dimensions and locations have been made on the basis of hydrological investigations. Special ditch requirements have also been noted, and areas of erosion and sedimentation mapped. No particularly troublesome features are anticipated.

DESIGN CRITERIA

Interstate highway design standards ordinarily used could not be strictly adhered to in the mountainous Mullan - Saltese area. Minimum values were adopted with maximum horizontal curvature set at seven and a half degrees, maximum gradient at seven percent, and design speed at 50 miles per hour in consideration for stopping and passing situations.

Figure 7 illustrates a typical cross-sectional view for the proposed four lane divided highway. The 25 feet wide "benches" at vertical intervals of 50 feet are particularly effective in deep cut sections. These berms or terraces are designed to provide snow storage and to minimize the severity of rockfall and snowslides. The widened roadside ditch will supplement the bench feature.

Bridge widths were assumed to be 76 feet for short structures and 60 feet for longer structures.

Tunnel installations were designed for vertical clearances of 16'3" at curb line. A two-lane tunnel would be 28 feet between curbs and a three-lane facility would be 40 feet wide.

Roadway and structure designs are based on policies and specifications of the American Association of State Highway Officials and the U.S. Bureau of Public Roads.

TYPICAL FREEWAY SECTION

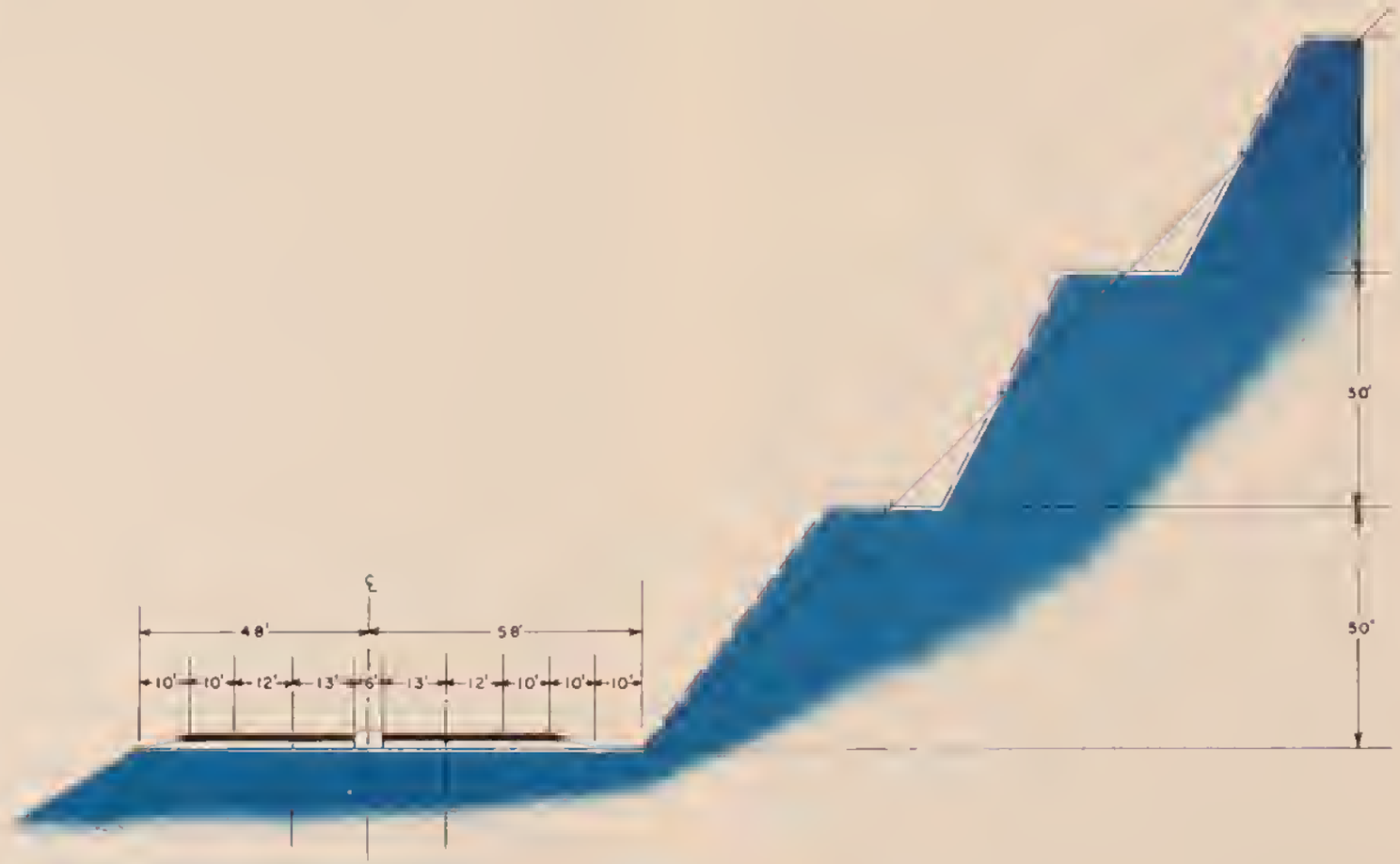


FIGURE 7

GENERAL DESCRIPTION COMBINED MONTANA AND IDAHO PLANS

The Idaho terminal for all combined plans was located near the east city limits of Mullan; in Montana, the common terminal was situated one mile east of Saltese. Both points lay quite close to existing U.S. Highway 10, as indicated in Figure 8.

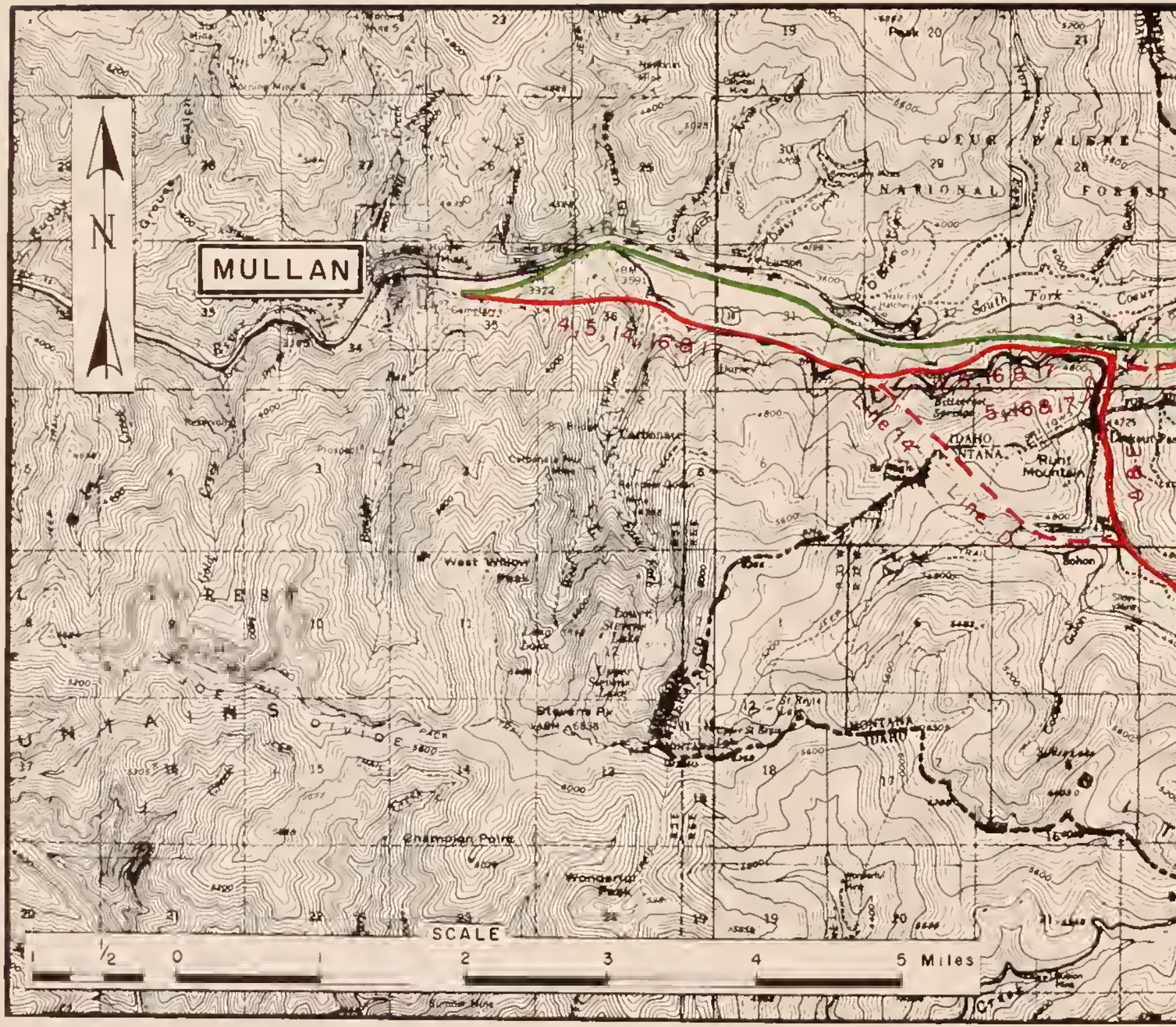
Geographic Controls

The three natural mountain passes were primary control for route direction. Mullan Pass, elevation 5,180 feet, is the northernmost crossing; Lookout Pass, three miles to the southwest, is 4,725 feet at the highest point on U.S. Highway 10; St. Regis Pass, elevation 4,900 feet, is a mile southwest of Lookout Pass.

Aerial photographs of the three passes are reproduced on page 17.

Other natural controls in route alignment included the ridge-and draw-topography, the two major rivers in the area, and the Osburn Fault.

The presence of the Northern Pacific Railroad's Wallace Spur influenced route placement in both states, and Montana faced additional problems in its sector due to the location of the Chicago-Milwaukee-St. Paul and Pacific Railroad for five miles west of the eastern terminus.



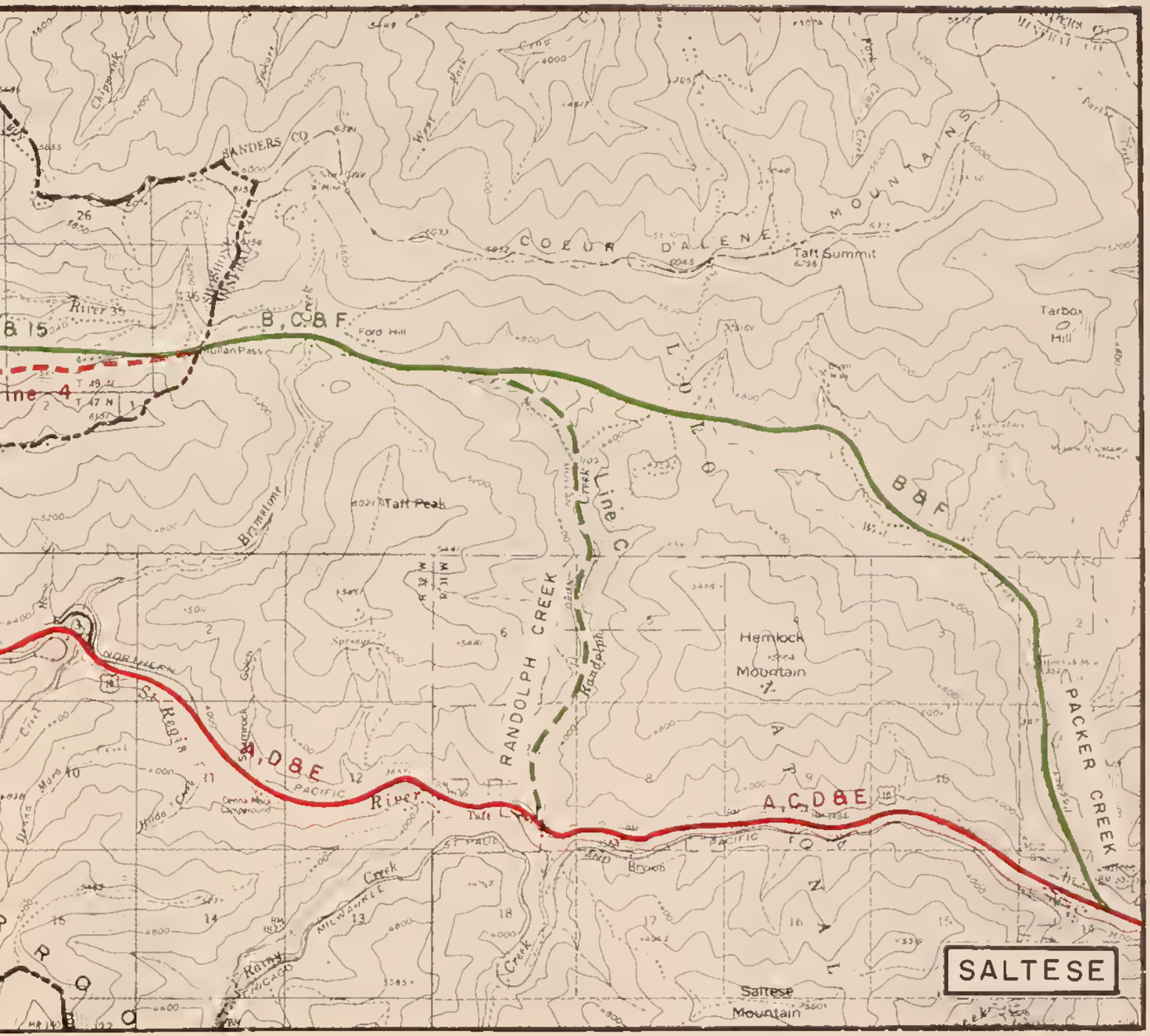


FIGURE 8

Highway Design Controls

Identical design standards were applied to all plans except in the matter of maximum grades. (See "Design Criteria", page 13.) This resulted in investigation of generally similar alignments - with five percent and seven percent maximum grades - on much the same surface locations through each of the passes.

Plans which were located with the restriction to five percent gradient generally tended to be longer than those with steeper grades.

Basic Routes

Eleven individual routes, formed by combining various Idaho and Montana plans, were located:

Surface Routes	Number of Plans
Mullan Pass (via Packer Creek in Montana)	3
Mullan Pass (via Randolph Creek in Montana)	2
Lookout Pass	3
Tunnel Routes	
Mullan Pass	1
Lookout Pass	1
St. Regis Pass	1

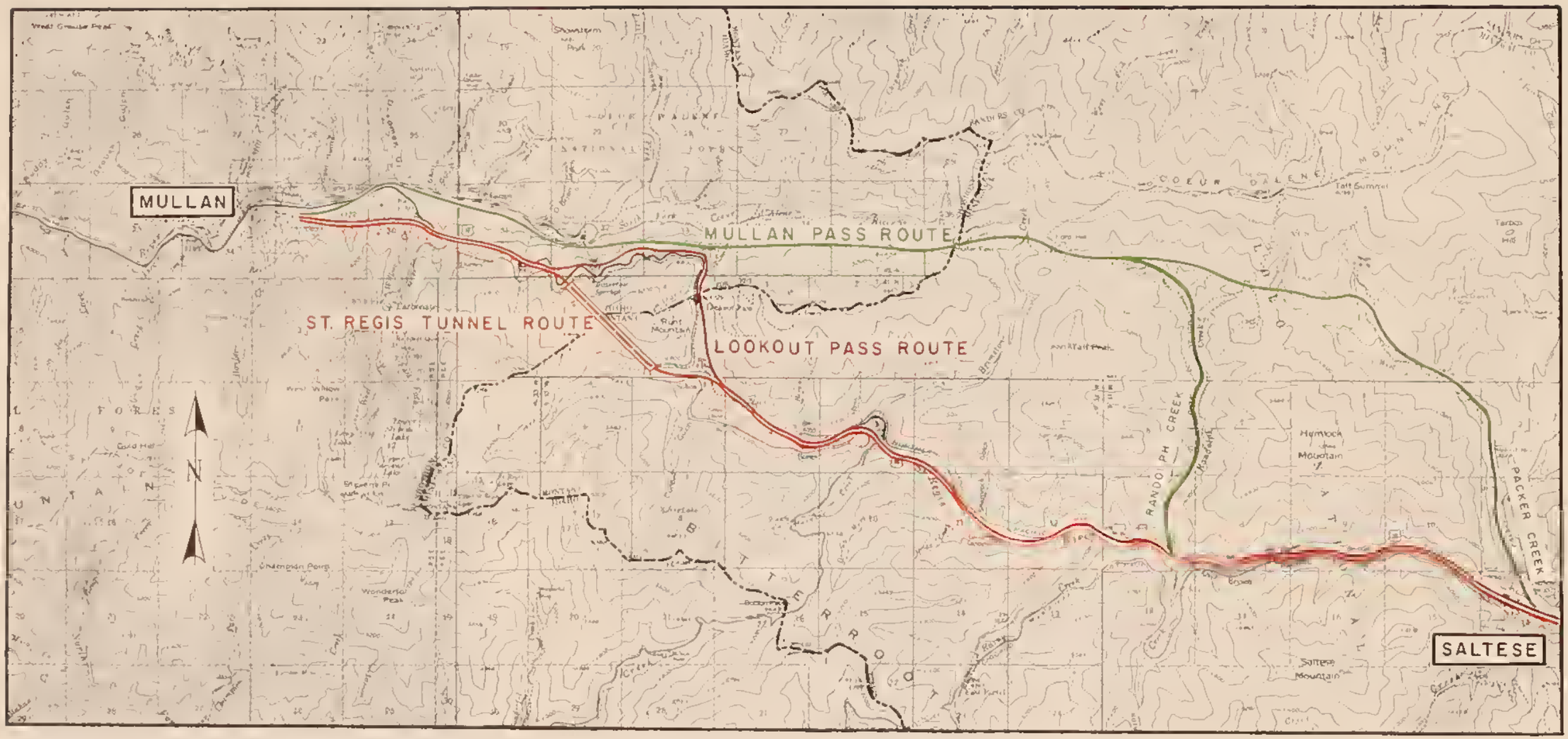


FIGURE 9 **TERMINALS, PASSES AND ROUTES**

A map of the study area showing the general location of each plan is shown in Figure 8. Nine tentative Idaho plans abandoned during very early planning stages are not shown. These routes were aligned along the north side of the Coeur d'Alene Valley and terminated at Mullan Pass or looped back across the valley to Lookout or St. Regis Pass. Extreme length, excessive expense, and fault or avalanche problems caused these plans to be disqualified.

Figure 9 is a general alignment map for remaining plans.

Mullan Pass Routes

Idaho and Montana plans connecting at Mullan Pass formed six potential combinations. Of these, three surface plans would require maximum grades of seven percent; two surface plans and one tunnel plan would

Above - -
Mullan Pass viewed from Idaho, showing the Old Mullan Road.

have 5.1 percent maximum grades. Horizontal curves would range up to seven degrees in Idaho and seven and one-half degrees in Montana. These plans range in length from 16.43 to 18.53 miles.

Lookout Pass Routes

Three Idaho and three Montana plans join at Lookout Pass. These combinations allowed an analysis of four possibilities: two surface plans requiring maximum grades of 6.5 and 6.8 percent, and one surface plan which would have grades up to 5.2 percent. A tunnel plan would be on maximum 5.4 percent grade. Montana sections of these plans would allow use of five degree horizontal curvature; Idaho's sections would range up to seven degrees. Plan length varies by only one-tenth of a mile - from 16.27 to 16.37 miles.

St. Regis Pass Tunnel Route

A 15.53 mile plan formed by an Idaho section with 5.1 percent maximum grade and a Montana section having 5.0 percent grade join via a 7,000 foot summit tunnel beneath St. Regis Pass. Grade in the tunnel itself would be 4.14 percent. Maximum curvature would be five degrees in Montana and seven degrees in Idaho.

No feasible surface routes were found through St. Regis Pass due to steep slopes on the pass approaches. This condition would involve extraordinary summit excavation or much out-of-direction alignment for a surface route; either condition would undoubtedly result in prohibitive construction costs.

Right (above) - -
Lookout Pass, looking into Montana, showing U.S. Highway 10, the Northern Pacific Railroad, and the summit ski area.

Right (below) - -
St. Regis Pass, immediately left of Lookout Pass ski area, viewed from Montana.

ECONOMIC ASPECTS

Construction Costs

A 16.31 mile plan costing $16,116,000 to construct was the route with lowest construction costs. (By contrast, the 624 mile Mullan Road cost $230,000 to construct - slightly more than one percent of the larger figure!)

Total construction costs for each route are shown in the Summary Table, page 22.

The July 1960 agreement between Idaho and Montana stipulated that current unit prices for construction items were to be used in computing route construction costs. To assure coordination, the heavy construction cost - indexes then in effect in each state were used as an estimating basis.

Route cross sections were carded from photogrammetric contour maps, and earthwork quantities derived by use of electronic computers.

Cost of bridges and similar features were estimated for each individual structure. Culvert requirements were specified as a result of hydrological studies. Costs of channel changes and drain ditches were also included.

Special items, such as detour roads, relocation of railroad trackage and an interchange to serve Lookout Pass ski area were also included.

Tunnel costs were estimated from cost records of other highway departments with experience in tunnel construction.

Costs of construction-engineering and contingencies were included in unit prices rather than being estimated separately.

Annual Transportation Costs

Annual transportation costs include construction costs pro-rated to a yearly basis, the annual maintenance costs, and annual road user costs for each route. This grouping of costs is one of the most useful factors in route comparisons. Annual transportation costs for all routes are shown in the Summary Table, page 22.

Annual Construction Costs

To establish annual construction costs for each route studied, total costs were amortized at four percent interest rate. Average life expectancy of major construction items was estimated as follows:

ITEM	YEARS
Right of Way	50
Structures	50
Tunnels	50
Grading	40
Drainage Structures	40
Base	20
Surfacing	20
Traffic Devices	20

Annual construction costs were found to range from $900,000 to $1,600,000 for the 11 plans shown in the Summary Table.

Annual Maintenance Costs

Maintenance costs on the surface routes were developed from an evaluation of similar costs on existing U.S. Highway 10 in the study area. The figures were expanded in view of the greater dimensions of the Interstate Highway, resulting in a figure of $3,500 per mile. This was broken down as follows:

$1,000/mile - - General Maintenance (Harvesting empty bottles and other litter)
$2,500/mile - - Special Maintenance (Snow plowing, sanding, etc.)

Annual tunnel maintenance costs were developed from maintenance records of other state highway departments. These costs vary according to tunnel widths, as indicated below:

2-lane tunnel - - - - $ 55,000 per mile
3-lane tunnel - - - - $ 64,000 per mile
two 2-lane tunnels- - $110,000 per mile

Lengths of possible tunnels investigated in this route study measured 0.38, 0.43, and 1.27 miles. High maintenance costs are due in part to the necessity of operating standby equipment to clear tunnel routes in the event of an accident or breakdown.

Annual maintenance costs for all routes are shown in the Summary Table.

Annual Road User Costs

Determination of road user costs takes into account the cost of all items of vehicle ownership and operation, including values for time, comfort and convenience. The basic unit of measurement is expressed in cents per vehicle mile. Total road user costs in proportion to initial cost and upkeep, provide an accurate estimate of a highway's economic feasibility.

Sources normally used to define vehicle operating costs did not adequately express such values for driving on sustained steep grades such as those proposed for the plans evaluated in this study. This problem was further compounded by the extensive curvature associated with gradient. Therefore, a more detailed approach to the computation of road user costs was developed.

Operating costs were based on the distribution of passenger and commercial vehicles moving through the study area. Costs for both vehicle types were combined and a composite figure derived. Average operating speeds were determined, which allowed the computation of time costs. Values of $1.55 per hour for passenger vehicles and $3.00 per hour for commercial vehicles were assigned. These calculations provided a composite of operating costs and time cost for an average vehicle operating over one highway mile.

Road user costs for a highway not yet built are computed for vehicle volumes of some future date - in this case 1975 - so that a clear relationship between construction costs and costs to the traveling public may be established.

The forecast of 3,600 vehicles daily between Mullan and Saltese for 1975 were expanded from existing volumes, as explained under "Future Traffic Volumes". By multiplying the cost per-vehicle-mile by the length of each plan, the cost that would be incurred in operating one vehicle over the road's length is made known. Then, the anticipated average daily traffic (ADT) is multiplied by 365 to find the total annual volumes. Finally, the annual volumes are multiplied by the cost of operating one vehicle over each route, thus producing a total annual road user cost for evaluative purposes.

Figure 10 indicates the relationship between gradient and vehicle operating costs.

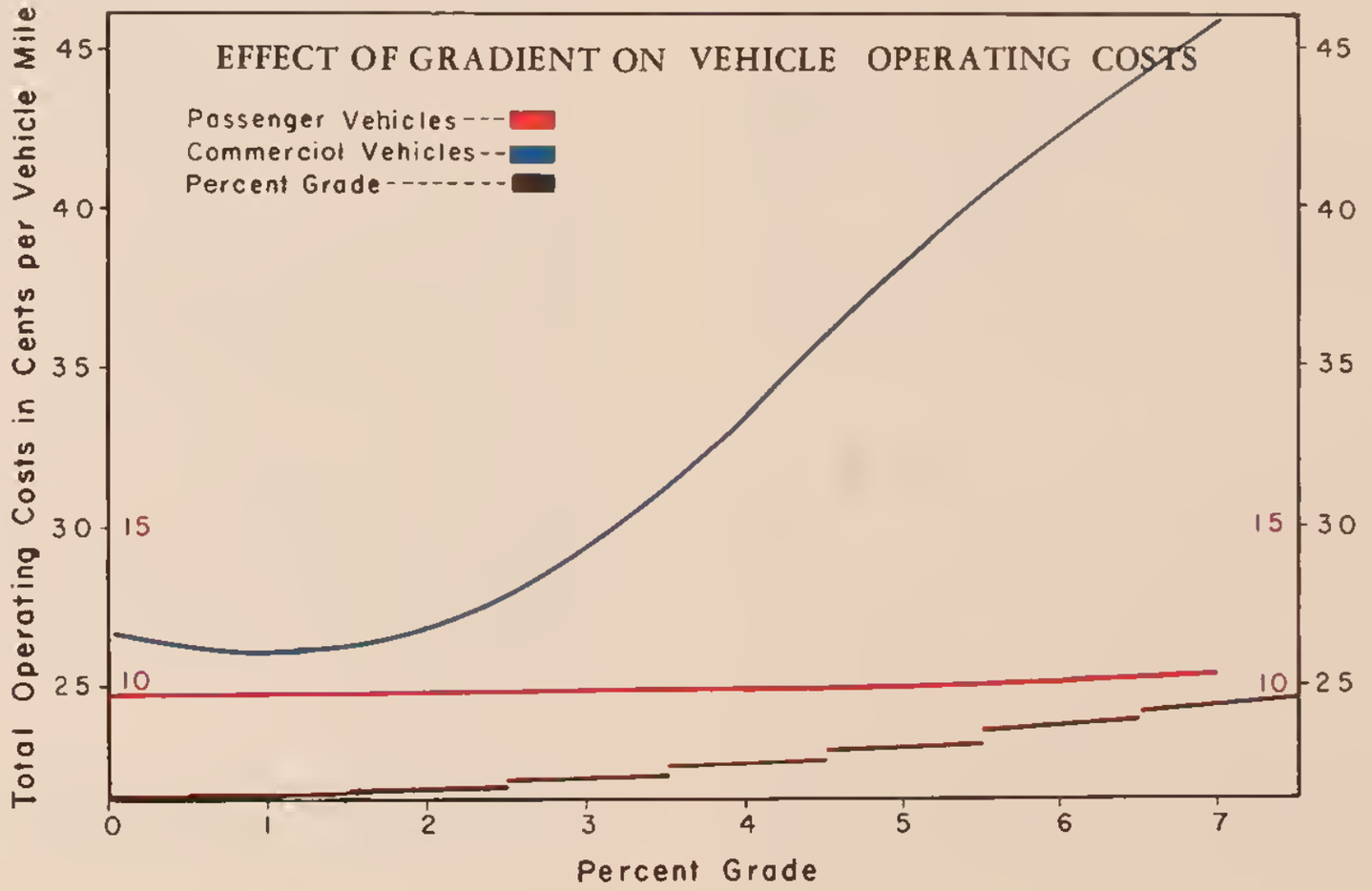


FIGURE 10

PLAN EVALUATION

As indicated by the Summary Table, final plan selection had to be made from among eleven potential routes, each with varying degrees of desirability. A plan was sought which would best meet the requirements of both states for reasonable construction and annual costs, and which would provide safe, efficient service to the traveling public.

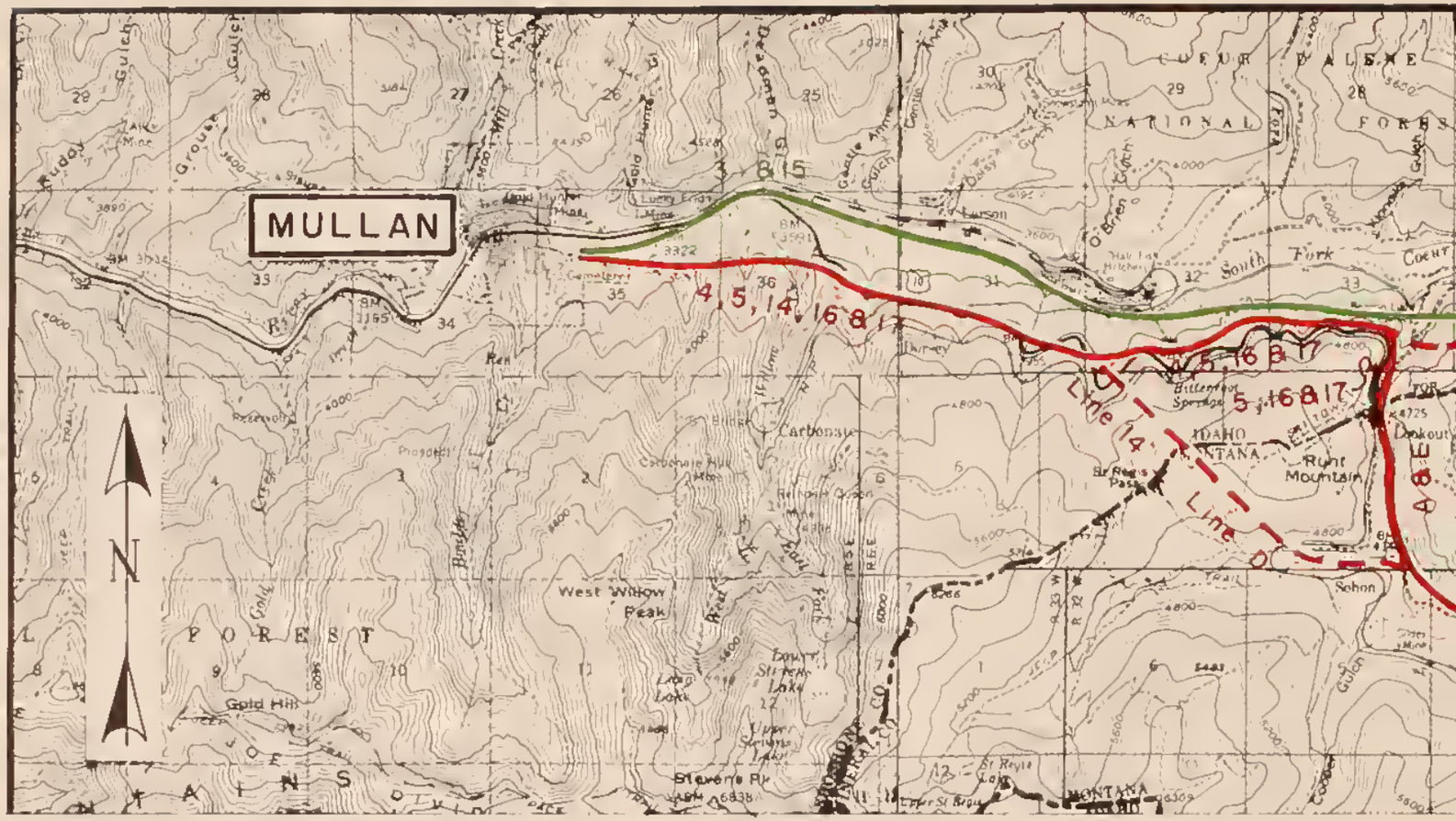
In addition to economy and traffic service, the elements of terrain and climate (with their combined effect on winter operating conditions), geological and avalanche circumstances, and the proximity of Northern Pacific Railroad property were of major importance in plan evaluation.

In order to separate the most favorable possible routes from the many considered, the plans were evaluated in two stages.

Stage One

Of the 11 plans compared in the Summary Table, Plans 3-B7, 4-B7, 3-C7 and 16-A7 would result in maximum grades above optimum desirability.

As the alignment map, Figure 11 indicates, Plans 3-C7 and 4-B7 would be faced with the further disadvantage of poor exposure for almost their entire length. The combination of steep grade and poor exposure would create hazardous operating conditions, particularly at structure approaches. Additionally, Plan 3-C7 is 1.14 miles longer than average plan length, and Plan 4-B7 three-hundreths of a mile, resulting in slightly higher annual transportation costs. Furthermore, these plans are remote from developed areas at Lookout Pass, to which access would have to be provided via the existing highway. This parallel service would create unnecessary added costs. Therefore, Plans 3-C7 and 4-B7 were excluded from further consideration.



Plans 3-B7 and 16-A7, although having proposed grades of questionable desirability, featured, respectively, the third lowest and lowest construction costs and annual transportation costs. In view of this, it was considered necessary to include these two plans in any realistic final comparison.

Plans 4-B5, 4-C5, 15-F, and 5-E would require the longest routes, with correspondingly high construction costs. This condition is a result of the moderate grades in both states, which range between 5.0 and 5.4 percent. Annual transportation costs likewise reflect the lengths of these plans. Plan 5-E is 0.36 miles shorter than average plan length; Plans 4-B5, 4-C5, and 15-F exceed average length by 0.30 to 1.80 miles.

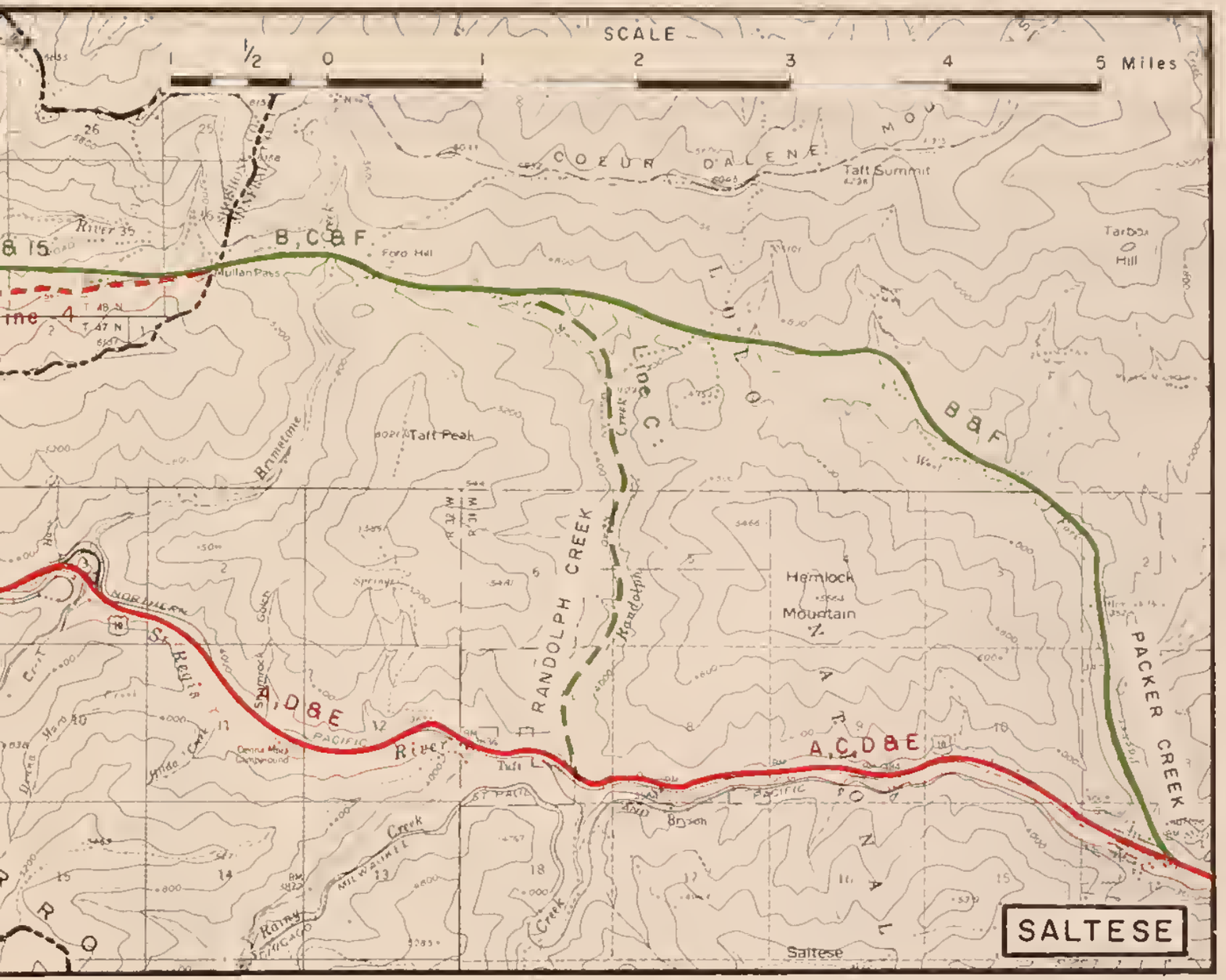


FIGURE 11 ALIGNMENT COMPARISON

Plans 4-B5 and 4-C5, third longest and longest, respectively, also ranked in that order in terms of construction costs and annual transportation costs. Furthermore, these two plans would require poorly exposed highway location for extensive sections. Due to the remoteness of these plans from built-up facilities at Lookout Pass, the existing highway would have to be maintained. This would provide parallel service in an area where it is not required, and would impose severe maintenance costs on both states. Therefore, Plans 4-B5 and 4-C5 were eliminated from evaluation.

Plans 15-F and 5-E, both tunnel routes, are nearly half a mile below average plan length of 16.73 miles. Plan 15-F would result in fourth highest construction costs and third highest annual transportation costs. However, the fact that location of the tunnel structure proper would be in the shear zone of the Osburn Fault was, in itself, sufficient cause to eliminate this plan from further consideration.

Plan 5-E would require a tunnel 2,000 feet in length. In addition to being less than average length, this plan would have lower than average annual transportation costs, although costing $670,000 more to build than the average plan cost. Geologically, however, the unconsolidated material of this tunnel site is not considered stable enough for such construction, which removed Plan 5-E from additional evaluation.

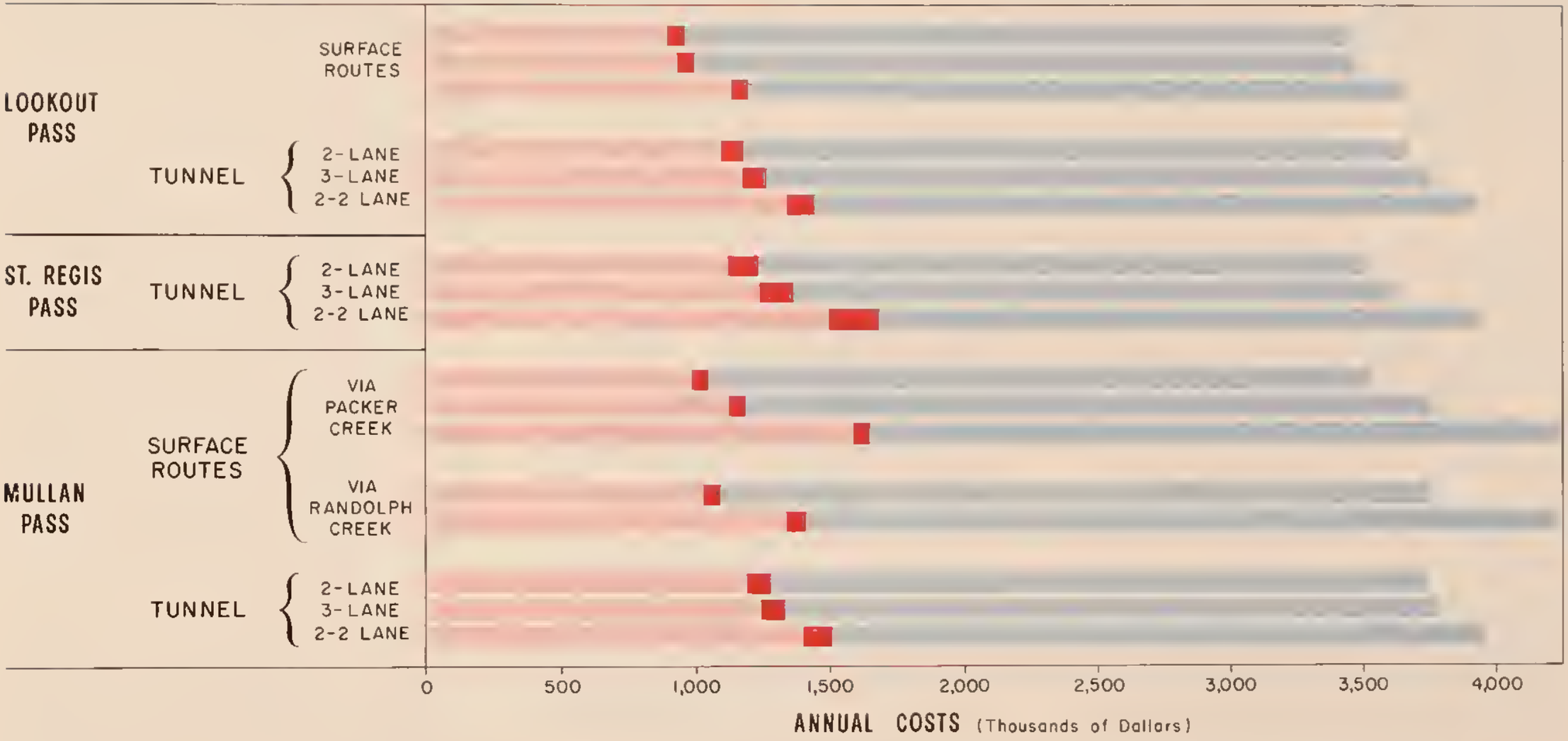
The elimination of surface Plans 3-C7, 4-B7, 4-B5, 4-C5, and tunnel plans 15-F and 5-E from further comparison, left five competitive alternatives from which plan selection could be made in Stage Two of the evaluative process.

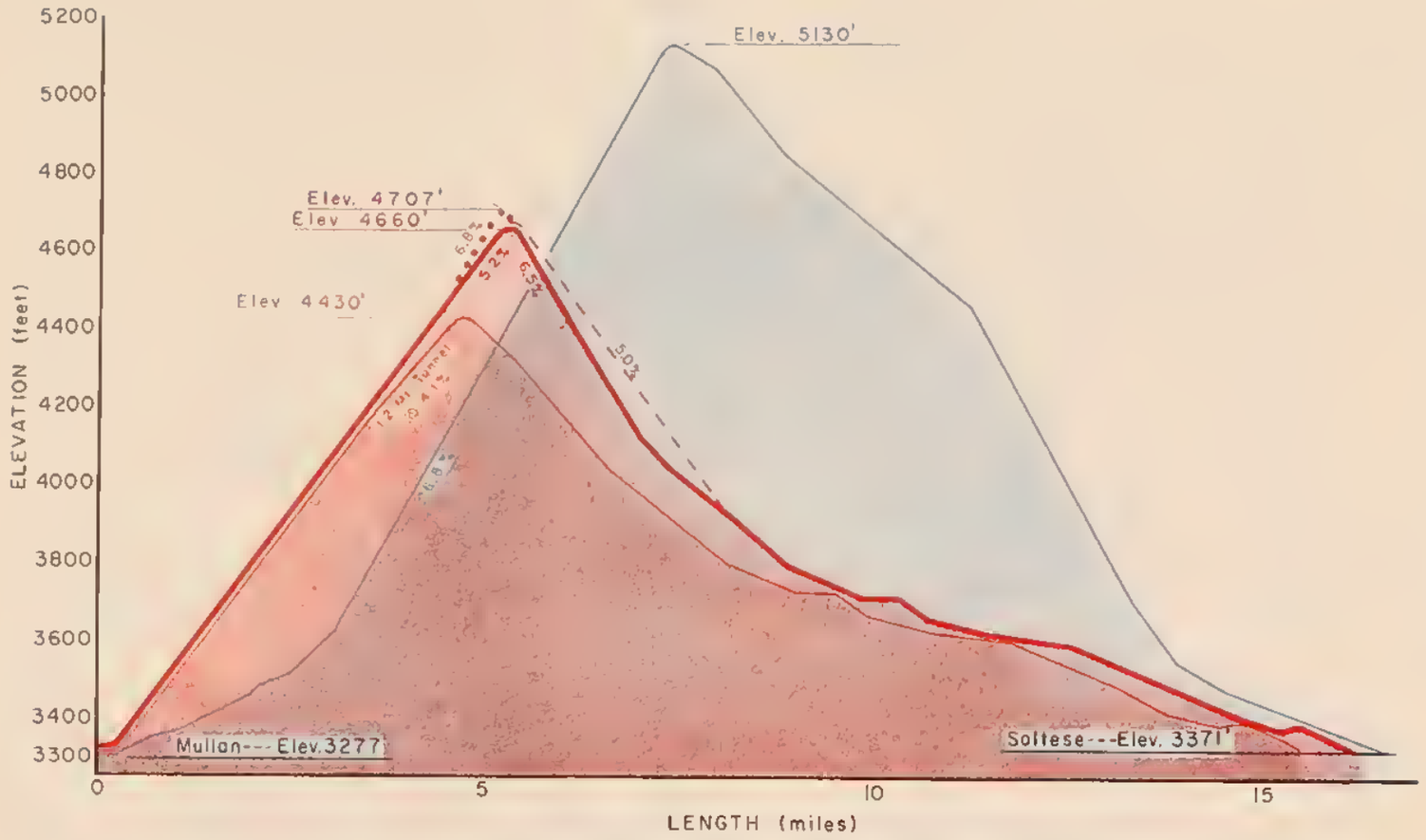
SUMMARY OF ECONOMIC ASPECTS

			PLAN NUMBER IDAHO - MONT.	LENGTH	MAXIMUM GRADE IDAHO	MAXIMUM GRADE MONT.	TOTAL CONSTR. COST	ANNUAL COSTS: CONSTR. COST	ANNUAL COSTS: MAINT. COST	ANNUAL COSTS: ROAD USER COST	ANNUAL COSTS: TOTAL TRANSPT. COST
LOOKOUT PASS	SURFACE ROUTES		16-A7	16.31	6.8	6.5	$16,116	$ 902	$ 57	$2,479	$3,438
			17-A7	16.34	5.2	6.5	16,870	942	57	2,463	3,462
			17-A5	16.27	5.2	5.0	20,820	1,139	57	2,448	3,644
	TUNNEL	2-LANE	5-E	16.37	5.1	5.4	20,699	1,110	79	2,478	3,667
		3-LANE	5-E	16.37	5.1	5.4	22,171	1,179	83	2,478	3,740
		2-2 LANE	5-E	16.37	5.1	5.4	25,865	1,351	102	2,478	3,931
ST. REGIS PASS	TUNNEL	2-LANE	14-D	15.53	5.1	5.0	21,519	1,124	116	2,277	3,517
		3-LANE	14-D	15.53	5.1	5.0	24,225	1,250	128	2,253	3,631
		2-2 LANE	14-D	15.53	5.1	5.0	29,659	1,502	186	2,251	3,939
MULLAN PASS	SURFACE ROUTES	VIA PACKER CREEK	3-B7	16.55	6.8	7.0	18,478	998	58	2,482	3,538
			4-B7	16.76	5.1	7.0	20,839	1,133	59	2,568	3,760
			4-B5	17.03	5.1	5.0	30,017	1,598	60	2,616	4,274
		VIA RANOOLPH CREEK	3-C7	17.87	6.8	7.0	19,076	1,034	62	2,667	3,763
			4-C5	18.53	5.1	5.0	25,098	1,355	65	2,829	4,249
	TUNNEL	2-LANE	15-F	16.43	5.1	7.0	22,623	1,196	86	2,449	3,731
		3-LANE	15-F	16.43	5.1	7.0	23,931	1,256	90	2,449	3,795
		2-2 LANE	15-F	16.43	5.1	7.0	27,215	1,410	107	2,449	3,966

NOTE: Construction costs include paving estimates computed for use of asphaltic concrete on all sections of roadway.

ANNUAL CONSTRUCTION COST + MAINTENANCE COST + ROAD USER COST = TOTAL ANNUAL TRANSPORTATION COSTS





Route		Max. Grade		Max. Curve		Length	Total	Annual Costs (Thousands of Dollars)			
Line	Summit	Idaho	Mont.	Idaho	Mont.		Const. Cost	Construction	Maintenance	Road User	Total
14 - D	St. Regis (3 Ln. Tunnel)	5.1%	5.0%	3960 ft. 7°	5°	15.53	24,225	1,250	128	2,253	3,631
3-B7	Mullan	6.8%	7.0%	5670 ft. 7°	6°	16.55	18,478	998	58	2,482	3,538
17-A7	Lookout	5.2%	6.5%	12,160 ft 7°	5°	16.34	16,870	942	57	2,463	3,462
17-A5	Lookout	5.2%	5.0%	12,160 ft. 7°	1100 ft 7°30'	16.27	20,820	1,139	57	2,448	3,644
16-A7	Lookout	6.8%	6.5%	12,990 ft 7°	5°	16.31	16,116	902	57	2,479	3,438

FIGURE 12 SUMMARY OF FIVE MOST COMPETITIVE PLANS

Stage Two

In order to assure an all weather highway through the study area, it would be important to utilize those sections of alignment with the most moderate grades available. This was considered to be particularly vital in Idaho, where the steep natural slopes, heavy winter snowfalls and severe icing conditions would assure potentially hazardous operating conditions - especially on the more poorly exposed routes. Since these conditions are not so pronounced east of the summit, slightly steeper grades could be tolerated there.

In addition to the favorable effect on safe operation, moderate grades act to decrease the cost of vehicle operation, as was shown by Figure 10 in the section entitled, "Road User Costs."

Therefore, gradient requirements on the remaining combined plans were considered to hold precedence over strictly economic advantages in the process of plan selection, especially in view of the relatively close ranking of the five most desirable plans for length, construction costs, and annual transportation costs. This comparison is shown in the Condensed Summary Table in Figure 12.

The Mullan Pass surface route, St. Regis tunnel route, and three Lookout Pass surface routes remained after the eliminating process. These alignments are shown in Figure 11. Gradient is compared in Figure 12. The table presented with Figure 12 shows length, maximum curvature, initial construction costs, and annual transportation costs of the various plans.

Mullan Pass Route

Plan 3-B7 has four miles of 6.8 percent grade in Idaho and two miles of 7.0 percent grade in Montana. Three structures are located on the sustained steep Idaho grade. Profile adjustments would be necessary at these locations to provide a maximum of 5 percent structure grade.

This plan also has a higher summit elevation (Figure 12) and 4.5 miles of poorly exposed north slope roadway, assuring more critical winter conditions than would be the case on Lookout Pass or St. Regis Pass alternates. Furthermore, Line 3-B7 has the third highest construction costs and next to highest annual transportation costs of plans retained for final comparison. It crosses more faults and shear zones than do other alternates. This plan would require local area maintenance of the existing highway to give access to the Lookout Pass ski area.

From the summary comparison of the five remaining plans presented in Figure 12, it is apparent that Lookout Pass Plans 16-A7 and 17-A7 are superior in all respects to the Mullan Pass route. These Lookout Pass plans provide shorter length, lower summit elevation, lower construction and annual transportation costs, greater local service and better adaptability to stage construction.

Based on these comparisons, the Mullan Pass route was removed from further consideration.

St. Regis Tunnel Route Vs. Lookout Pass Surface Route

Initial cost of the St. Regis route would be $24,225,000 assuming that a three-lane tunnel is considered. A two-lane tunnel on this gradient was shown to reach practical capacity by about 1975. Construction of dual two-lane tunnels would make this alternate vastly more expensive than any of the surface routes.

Although three-quarters of a mile shorter than the shortest surface alternate, its initial construction and annual transportation costs are high. Annual maintenance costs are highest of all plans, the tunnel alone requiring an expenditure of $70,000 per year.

Geologically, St. Regis Pass is ruptured by minor faults associated with the major Silver Creek Fault. However, these minor faults do not show wide fracture zones. Test borings indicate the existence of fairly competent beds of argillite and quartzite beneath a heavy mantle of overburden. The rock itself showed fracture below 80 feet.

Extensive subsurface investigation along the proposed tunnel line would have to be completed before any final conclusion as to rock type and character could be drawn. Discovery of great areas of unconsolidated material would increase construction costs considerably and possibly show this route uneconomical.

The St. Regis Pass Tunnel route provides basically three advantages:

1. Maximum gradient of 5.1 percent.
2. Lower summit elevation, thereby reducing winter problems resulting from snow and ice.
3. Seven-tenths of a mile shorter than the shortest Lookout Pass route.

The two most favorable Lookout Pass surface routes provide these five advantages when contrasted with the St. Regis Pass tunnel route:

1. A four-lane divided highway full length of the route compared to a section of three-lane undivided highway for the tunnel and tunnel approaches.
2. Lower construction costs - $16,116,000 to $16,870,000 vs. $24,225,000.
3. Lower annual transportation costs-$3,438,000 to $3,462,000 vs. $3,631,000.
4. Lower annual maintenance costs - $57,000 vs. $128,000.
5. Provision of a detour road which would be available for local uses and other purposes.

Analysis of the favorable aspects of each plan leads to the conclusion that the Lookout Pass surface route advantages outweigh those of the St. Regis Pass Tunnel route.

The three-lane tunnel, while serving advantageously during the four winter months, would become a definite disadvantage during the remaining eight months - the period during which greatest traffic volumes occur.

The seven-tenths of a mile distance reduction associated with the St. Regis Tunnel is not sufficient to justify the over $7 million additional construction costs. Resulting construction costs and annual transportation costs favor the Lookout Pass routes by quite a wide margin.

Right - -
An exposed section of the extensive Osburn Fault Zone. Crushing and shearing forces produced by earth movements resulted in the pulverized effects apparent in this photograph. Smaller faults were also detected. Traces of fault by-products in drilling records helped rule out potential tunnel structures.

As of mid-February 1964, total snowfall to date measured 141 inches which had settled to a depth of 116 inches.

Wintertime highway maintenance requires the use of special procedures and equipment to keep U.S. Highway 10 open across Lookout Pass. Idaho and Montana personnel, manning equipment such as these rotary snowplows, are on 24-hour alert to combat the effects of winter storms.

These specialized operations greatly increase normal maintenance costs. It has been estimated that snowplowing and sanding will add approximately $1500 per mile, annually, to freeway maintenance expenses.

FINAL PLAN SELECTION

The foregoing analysis resulted in the agreement to use a Lookout Pass surface route location for the proposed section of Interstate Highway 90.

Idaho Routes to Lookout Pass

Idaho Plans 16 and 17 are located on the poorly exposed north slopes in much the same manner as the existing highway. The two plans are of nearly equal length, and have the same maximum horizontal curvature of seven degrees. A highway constructed on either route would experience maintenance difficulties and operational disadvantages caused by poor winter time exposure.

Gradient, however, is the primary differentiating factor between the two plans. Plan 16 would result in maximum grades of 6.8 percent and Plan 17, 5.2 percent. Since Plan 16 has the steepest grades, it is considered least desirable of the two. The cost of obtaining the 5.2 percent maximum grade of Plan 17 would amount to $754,000 over the cost of 6.8 percent gradient on Plan 16 - a five percent increase over the total cost of Plan 16.

In view of the foregoing considerations, it was concluded that Plan 17 would be the logical Idaho section for the combined alignment through Lookout Pass.

Montana Routes to Lookout Pass

Montana Plans A7 and A5 are located on well-exposed south and west slopes, thereby offering favorable winter operating conditions compared to those in Idaho. Furthermore, the reduced snowfall depths east of the summit would result in fewer maintenance problems than on the west.

Maximum gradient associated with Plan A5 was 3.3 miles of five percent grade; and 1.9 miles of from six to 6.5 percent grades with Plan A7. Plan A5, although seven-hundreths of a mile shorter than Plan A7, would cost $3,950,000 more to construct.

Because of favorable exposure and less winter precipitation, it is believed that the 6.5 percent maximum grades would be acceptable, since similar conditions presently exist on U.S. Highway 10, and have presented no serious problems.

Maximum horizontal curvature would be five degrees with Plan A7 and 7.5 degrees with Plan A5.

In view of the more favorable natural conditions in Montana, it was felt that steeper grades could be adopted there. This would also result in savings of $3,950,000 in construction costs for Plan A7 compared to Plan A5.

Therefore, it was decided to utilize Plan A7 as the Montana section of the Lookout Pass alignment.

Final plan recommendation, therefore, was for a combined surface alignment through Lookout Pass, as shown in Figure 13.

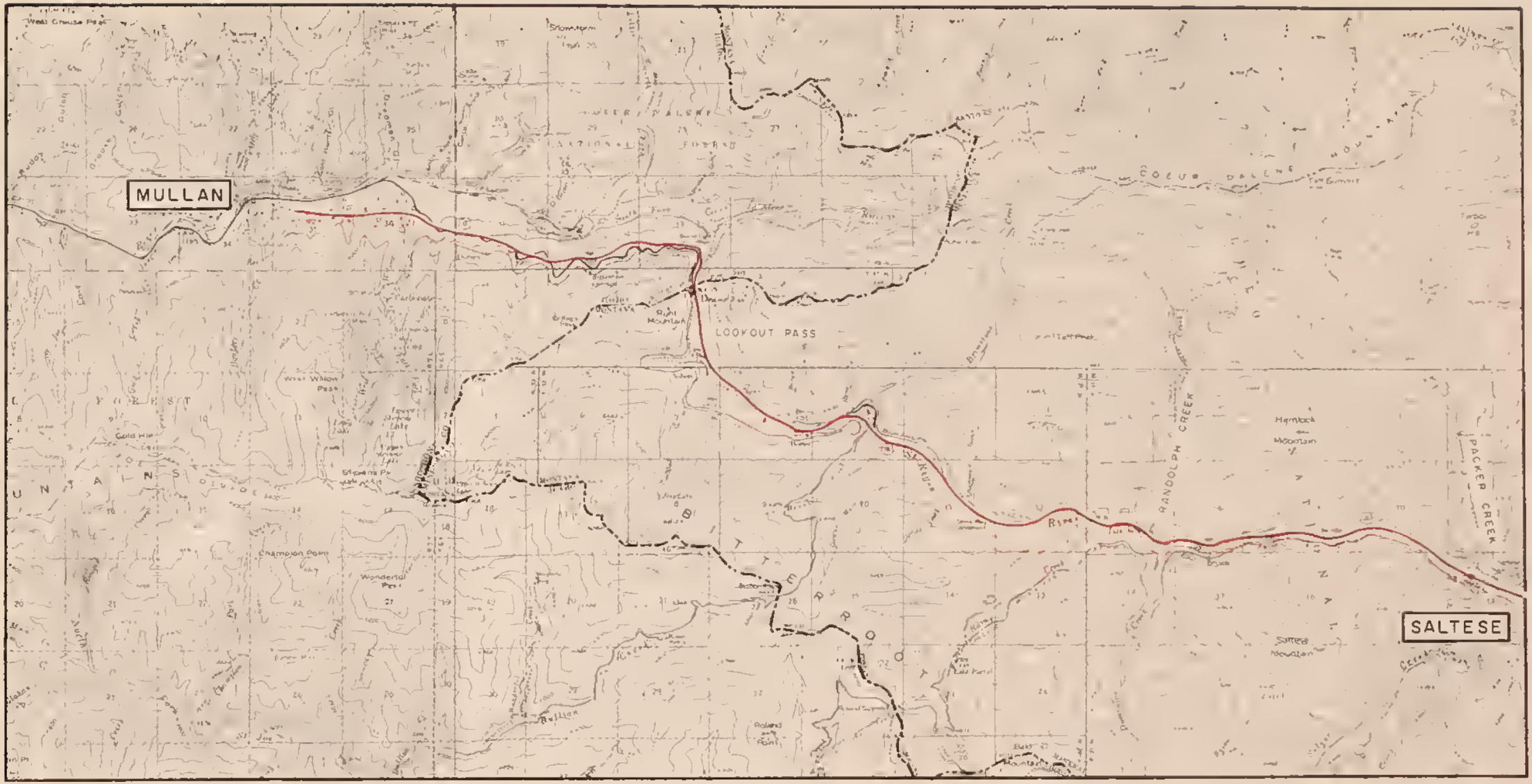


FIGURE 13

THE RECOMMENDED PLAN THROUGH LOOKOUT PASS

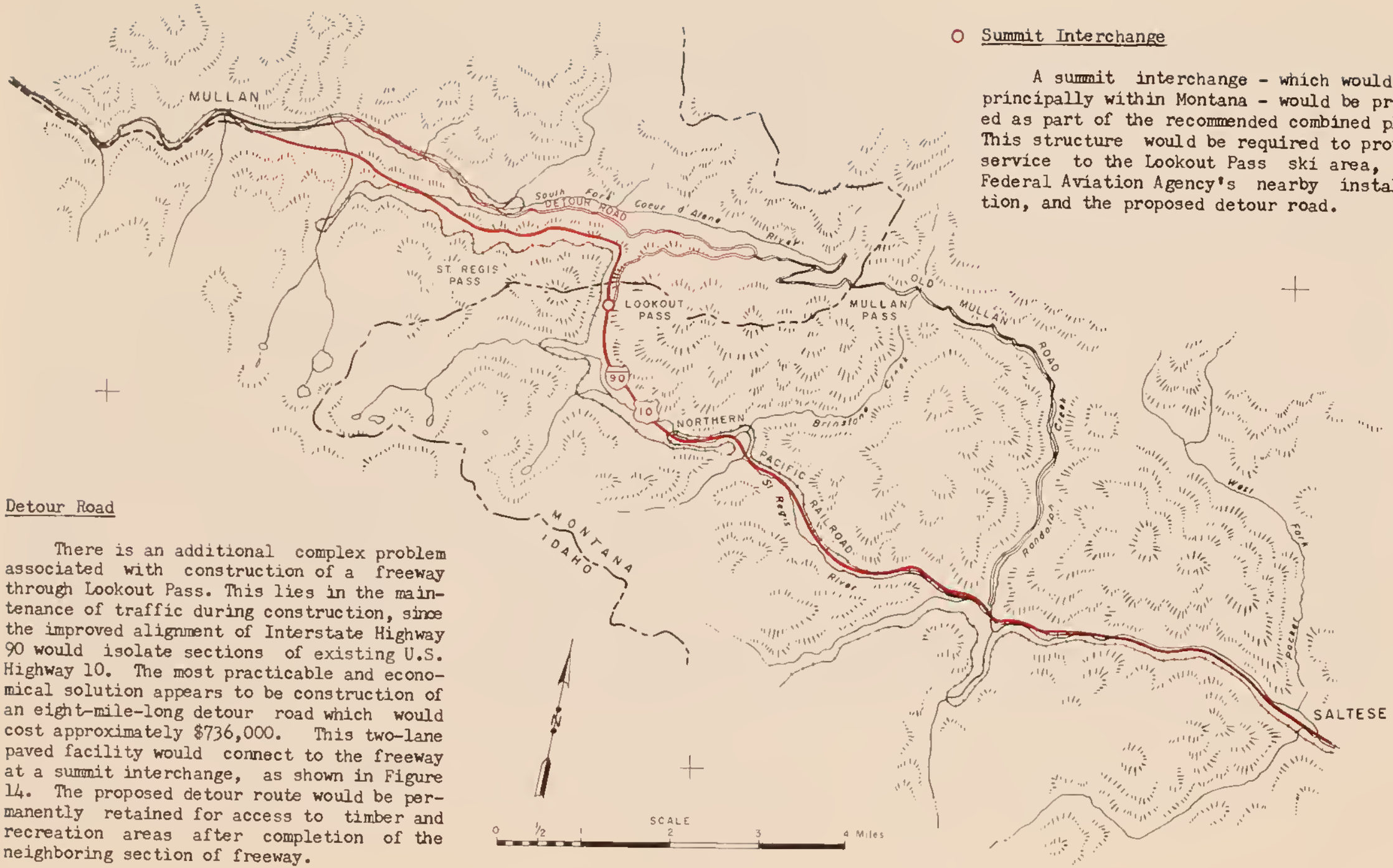


FIGURE 14

○ Summit Interchange

A summit interchange - which would lie principally within Montana - would be provided as part of the recommended combined plan. This structure would be required to provide service to the Lookout Pass ski area, the Federal Aviation Agency's nearby installation, and the proposed detour road.

Detour Road

There is an additional complex problem associated with construction of a freeway through Lookout Pass. This lies in the maintenance of traffic during construction, since the improved alignment of Interstate Highway 90 would isolate sections of existing U.S. Highway 10. The most practicable and economical solution appears to be construction of an eight-mile-long detour road which would cost approximately $736,000. This two-lane paved facility would connect to the freeway at a summit interchange, as shown in Figure 14. The proposed detour route would be permanently retained for access to timber and recreation areas after completion of the neighboring section of freeway.

Grade Modification

After agreement was reached to recommend the plan with 5.2 percent maximum Idaho grades and 6.5 percent maximum Montana grades, it was determined that the Montana gradient could be reduced somewhat at a moderate increase in cost.

Montana's maximum gradient was lowered to six percent on the approach to Lookout Pass by a slight alignment shift in both states. Greatest summit cut depth (nearly 100 feet) would occur just west of the state line in Idaho. Summit roadway elevation would be approximately 4665 feet, compared to 4725 feet on the existing highway.

The grade modification increased total construction costs of the recommended route to $17,103,000. Annual construction costs increased to $945,000, and total annual transportation costs to $3,465,000. These increases are not shown in the Summary Table on page 22, or in Figure 12, page 24.

Northern Pacific Railway

Presence of the Wallace Spur Line of the Northern Pacific Railway - in relation to the proposed highway route - creates several areas of concern. First, the freeway would cross the railroad once in Idaho and twice in Montana. Secondly, proximity of the railroad and the recommended route would require relocation of 2000 linear feet of track at Lookout Pass, a mile at Saltese, and possibly in other areas.

Public Hearings

Various State and Federal laws require that public hearings be held in communities affected by highway improvements. Towns and villages of the area concerned in this route study shall be afforded the opportunity for such hearings.

Additional informative documents shall be prepared for the public hearings to assure interested citizens of comprehensive advisement regarding the proposed route.

Phase Two

Following final approval by the respective State Highway Commissions and the Bureau of Public Roads, the Idaho-Montana Interstate Highway 90 Route Study will proceed to Phase Two. This second phase will feature photogrammetric mapping of the selected alignment, final detailed field location, geometric design, and construction programing.

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